

Performance  
Evaluation  
Report

# People's Republic of China: Yichang-Wanzhou Railway Project



Independent  
Evaluation



**Performance Evaluation Report**  
April 2016

**People's Republic of China:  
Yichang–Wanzhou Railway Project**

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Independent  
Evaluation  ADB

NOTE

- (i) In this report, "\$" refers to US dollars.

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# Abbreviations

ADB	–	Asian Development Bank
CRC	–	China Railway Corporation
EIRR	–	economic internal rate of return
EMP	–	environmental management plan
FCTIC	–	Foreign Capital and Technical Import Center
FIRR	–	financial internal rate of return
GDP	–	gross domestic product
HST	–	high-speed train
IEM	–	independent evaluation mission
MOR	–	Ministry of Railways
PCR	–	project completion report
PPER	–	project performance evaluation report
PRC	–	People's Republic of China
RRP	–	report and recommendation of the President
SEPP	–	soil erosion protection plan
TA	–	technical assistance
YWR	–	Yichang–Wanzhou Railway
YWRCH	–	Yichang–Wanzhou Railway Construction Headquarters
YYR	–	Yichang–Yaqueling Railway

# Weights and Measures

km	–	kilometer
km/h	–	kilometer per hour
m	–	meter
m <sup>2</sup>	–	square meter
<i>mu</i>	–	a Chinese unit of measurement (1 <i>mu</i> = 666.67 m <sup>2</sup> )
p-km	–	passenger-kilometer

# Currency Equivalents

Currency Unit — Yuan (CNY)

	<b>At Appraisal</b>	<b>At Completion</b>	<b>At Independent Evaluation</b>
	(18 November 2003)	(22 December 2010)	(30 September 2015)
CNY1.00 =	\$0.1208	\$0.1501	\$0.1572
\$1.00 =	CNY8.2770	CNY6.6630	CNY6.3620



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# Basic Data

## Yichang–Wanzhou Railway Project (Loan 2051-PRC)

Key Project Data (\$ million)	As per ADB Loan Documents	Actual
Total project cost	2,363.50	4,125.09
Foreign exchange cost	1,085.40	573.76
Local currency cost	1,278.10	3,551.32
ADB loan amount/utilization	500.00	500.00

Key Dates	Expected	Actual
Fact-finding		19 Nov–6 Dec 2002
Loan negotiations		5–8 Nov 2003
Board approval		15 Dec 2003
Loan agreement		27 May 2004
Loan effectiveness	25 Aug 2004	26 Jul 2004
Loan closing	30 Jun 2010	23 Dec 2011

**Borrower** People's Republic of China  
**Executing Agency** China Railway Corporation (former Ministry of Railways)

### Mission Data

Type of Mission	No. of Missions	No. of Person-Days
Fact-Finding	1	44
Appraisal	1	66
Inception	1	12
Loan review	6	70
Project completion	1	30
Independent evaluation	1	11

ADB = Asian Development Bank, No. = number, PRC = People's Republic of China.

Source: Asian Development Bank.



# Executive Summary

## Introduction

The Government of the People's Republic of China (PRC) has been increasing railway transport capacity to meet economic and social development needs. From 2001 to 2010, the government expanded the rail network by 30% from 70,057 kilometers (km) to 91,000 km. Despite this rapid expansion, strong transport demand derived from high economic growth resulted in serious constraints and bottlenecks for rail transport. The objectives of the Yichang–Wanzhou Railway (YWR) project were to help alleviate serious network bottlenecks, reduce transport costs by linking a shorter railway route, and promote pro-poor economic and social development.

## Project Outputs

The YWR was the first railway to be developed in the low-income region of Hubei Province, and it constituted an important 377 km component in the central PRC railway corridor, linking Yichang in Hubei Province and Wanzhou in Chongqing Municipality. Due to the difficult terrain, the YWR required numerous bridges (including two over the Yangtze River) and tunnels—74% of its total length is bridges and tunnels, which is the highest percentage among the PRC railways constructed before 2010. The government recognized the YWR as the most technically challenging railway project when the YWR was constructed given the complex topographical, geological, engineering, and hydrogeological conditions.

The loan documents did not provide any impact, outcome, or output targets. The project outputs were (i) construction of a 377 km railway; (ii) track laying and electrification; (iii) construction of freight yards; (iv) installation of train control system; (v) construction of new stations and expansion of existing stations; (vi) installation of equipment for operation; (vii) installation of environmental protection facilities; and (viii) institutional strengthening of Ministry of Railways, which was dissolved and succeeded by a newly established China Railway Corporation (CRC) in 2013.

The YWR was originally designed as a single-track railway with a project cost of \$2.36 billion to service both freight and passengers. Forecast revenues from passenger and freight volumes were about equally balanced. In December 2003, the Asian Development Bank (ADB) approved a \$500 million loan for the project that would be implemented during 2004–2010. This project was part of the Medium- and Long-Term Railway Development Plan to establish a nationwide high-speed railway network that was approved by the government in 2004.

In September 2006, the government revised the project scope from a single to a double track for the 288 km section from Yichang to Liangwu (close to Lichuan). The government also shifted YWR's role from a mixed railway to a passenger-predominant railway. The long-distance transit freight transport was dropped from the YWR's business scope, and the shift to double tracking resulted in a doubling of project costs. The construction for double-tracking started 2 years after the project start, and the change caused a 1-year delay because of the need to construct an additional tunnel.

Land acquisition and resettlement activities were adequately managed, and no adverse environmental impacts were identified. YWR operation started in December 2010 for both passenger and freight operations.

## Performance Assessment

**Relevance.** The original and revised project scopes were aligned with the government's development plans and priorities stated in the Tenth Five-Year Plan, 2001–2005 and the Eleventh Five-Year Plan, 2006–2010 and ADB's strategies at appraisal and evaluation. Although the change of project design achieved remarkable growth in passenger traffic, weaknesses in freight traffic forecasts at appraisal would have resulted in seriously low traffic volumes if the YWR had not been used predominantly for passengers. At the same time, the project design had innovative features, such as the introduction of technical risk management and advanced fiber-optic sensor technology, and lessons from the project were applied to other projects. The project is assessed *relevant*.

**Effectiveness.** Because of the absence of targets for outcomes and outputs in the loan documents, traffic estimates were used to evaluate effectiveness. The traffic projections in the loan documents were not revised following the change in scope and provided the basis of analysis. The design speeds of 160 kilometer per hour (km/h) for the double-tracked section and 120 km/h for the single-tracked section were achieved. The project reduced passenger transport bottlenecks on the national rail network, significantly increased the capacity of the East–West corridor, and lowered transport costs.

In 2011, the first full year of operation, YWR passenger traffic was 10.5 million, or 30% above passenger forecasts at appraisal. Passenger numbers doubled to 21.1 million in 2014—a usage level double the appraisal projections. With the opening of adjacent high-speed lines in the corridor, demand is expected to continue to increase steadily. YWR passenger numbers in 2015 were expected to be more than 25 million, or 2.5 times higher than the appraisal estimate and 40% higher than the project completion report (PCR) estimate. Recognizing the convenience of passenger train services, local governments along the YWR are now requesting CRC to open a new station, and increase a station's capacity to enable high-speed trains (HSTs) to stop there. As a result, the passenger component was highly successful. In comparison, the freight forecast component was unsuccessful. Freight traffic was much lower than estimated at appraisal, achieving less than 5% of the original forecast, as the YWR captures only local freight needs. Overall, the project is assessed *effective* in achieving expected outcomes.

**Efficiency.** The recalculated economic internal rate of return (EIRR) for the project was 14.1%, compared with the 14.4% estimated at appraisal and 15.6% estimated in the PCR. Despite higher capital costs for double tracking and shortfalls in freight traffic, there was no significant variance from appraisal estimates due to much higher passenger traffic flows than estimated. The EIRR exceeded the 12.0% cut-off rate, and the project was economically viable. Passenger traffic was the major source of economic benefits (71.0%), followed by tourism benefits (28.0%), which were not originally counted as transport benefits, and freight traffic (1.0%). Environmental and safety benefits and network benefits were not quantified, as data needed for the calculations was not readily available for the project performance evaluation report. The project is assessed *efficient*.

**Sustainability.** The recalculated financial internal rate of return (FIRR) was 5.7%, compared with the 5.8% estimated at appraisal and 3.9% estimated in the PCR. The variance from the PCR is mainly due to much higher passenger traffic and a higher tariff than estimated. Although the FIRR was recalculated conservatively, it was higher than the weighted average cost of capital of 2.5%, and the project is considered financially viable. The project is calculated to have produced a small positive cash flow for the first time in 2012. Its revenue is estimated to cover the operation and maintenance cost and depreciation after 2015, and the operation and maintenance cost, depreciation, and interest after 2018. CRC is expected to provide funding for maintenance and rehabilitation as well as repayment of YWR loans sourced from its own revenues. The evaluation found there was a sound institutional framework to meet operations and maintenance needs and environmental and safety requirements. As railways are energy efficient, the project will contribute to the reduction of carbon dioxide emissions. The project is assessed *likely sustainable*.

**Impact.** The project appears to have had an impact on socioeconomic development of poor provinces in Hubei, where the project is mainly located, and in poorer provinces in the western PRC. As a result of the strategy switch to develop the corridor to meet the needs of long-distance passengers (about 60% of passengers are transit passengers who do not use YWR stations), it is estimated that more than half of the benefits are derived from passengers from areas such as Sichuan Province and Chongqing Municipality. YWR's Yichang East Station contributed to the creation of a transport hub in Yichang City, which is rapidly expanding as one of the region's leading centers. Since the project is likely to have substantial positive development impacts and no significant negative effects, including safeguard issues, the project is assessed *significant*.

Overall, the project is rated *successful*. The project was implemented successfully despite being the PRC's most technically challenging railway project when the project was completed. It is part of one of the PRC's most important national transport corridors. The project achieved its main objectives of increasing corridor capacity, removing transport barriers, and reducing transport costs. It contributed to economic growth and poverty reduction in the project area and potentially in the western PRC. The reevaluated EIRR of 14.1% and FIRR of 5.7% confirm the project's economic viability and financial sustainability.

## Issues, Lessons, and Follow-up Actions

**Station location and capacity.** There is no passenger railway station on the single track between Lichuan and Wanzhou, although the section is 89 km long. A feasibility study is recommended to decide whether or not passenger railway stations should be opened along the single-track section, as this would benefit local people. Changyang Station on the double-track section is located in Changyang Tuji Autonomous County under the Yichang Prefecture. HSTs are not able to stop at the station since the platform length is not enough to accommodate them. HST stops at the station will increase benefits to the people in the minority county, whose population is about 400,000, while additional stops will lower benefits for transit passengers. Thus, a feasibility study of increasing Changyang Station's capacity is recommended.

**Capacity constraint on other railway lines in the freight corridor.** It was originally intended that the YWR would link the PRC's east and west for freight and passenger transport. However, the capacity constraint of several lines in this freight corridor prevents the extensive use of the YWR for freight, while a long-distance passenger railway corridor was established. This issue was set aside when the YWR's primary

purpose shifted to the development of the long-distance passenger railway corridor. However, several adjacent lines will become bottlenecks if freight trains on the YWR increase. Enhanced capacities of adjacent lines of YWR will be needed to increase YWR freight trains to meet local freight traffic needs and help develop the local area. Future railway plans need to analyze the capacity of the other railway lines that affect the project railway line.









**Intermodal freight transport.** In future planning of railways, given increasing competitiveness of inland waterways, intermodal transport combining railways and inland waterways needs to be considered. One reason for the overestimation of freight traffic at appraisal was the expectation that the freight traffic on the YWR would shift from inland waterways, but it did not happen. This is because (i) the tariff for inland waterways in the Yangtze River decreased significantly during this decade following the introduction of larger ships and (ii) a railway link with the Wanzhou port contributed to the increase of freight for inland waterways.

**Over-specification for double-stack containers.** The YWR was designed to accommodate double-stack container trains, and this has major implications for tunnels, which were all constructed to meet this requirement. Accommodating double-stack containers is a national standard for new railway lines, but double-stack containers are not yet used widely in the PRC. Although this is not an issue at the project level, there is a need to review whether this requirement is applied to all new railway lines or to follow-up on the future utilization plan for double-stack containers.

This evaluation found no follow-up actions on the project that need to be addressed.

# YICHANG–WANZHOU RAILWAY PROJECT IN THE PEOPLE'S REPUBLIC OF CHINA



- |   |   |   |                     |
|---|---|---|---------------------|
|  | Existing Track                                |  | Provincial Capital  |
|  | Project Railway                               |  | City/Town           |
|  | High Speed Railway Corridor                   |  | River               |
|  | Passenger Dedicated Line (Under Construction) |  | Provincial Boundary |

Boundaries are not necessarily authoritative.

This map was produced by the cartography unit of the Asian Development Bank. The boundaries, colors, denominations, and any other information shown on this map do not imply, on the part of the Asian Development Bank, any judgment on the legal status of any territory, or any endorsement or acceptance of such boundaries, colors, denominations, or information.





# CHAPTER 1

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## Introduction

### A. Project Description and Objectives

1. Railways are energy efficient, environment-friendly, safe, and cost efficient modes of transportation. Railways have competitive advantages in transporting heavy and bulk commodities over long distances and providing safe and speedy mass transport locally and between major cities. Because of the large land area and population size of the People's Republic of China (PRC), railways play an important role in transportation. The PRC government has been increasing the country's railway transport capacity to meet economic and social development needs. From 2001 to 2010, the government expanded the rail network by 30%, from 70,057 kilometers (km) to 91,000 km. Despite this rapid growth, strong transport demands derived from high economic growth resulted in serious constraints and bottlenecks for rail transport.

2. The objective of the Yichang–Wanzhou Railway (YWR) project was to help alleviate these network bottlenecks, reduce transport and logistics costs by linking a shorter railway route, and promote pro-poor economic and social development. The YWR was the first railway in the low-income region of Hubei Province, and it constituted an important 377 km component in the central PRC railway corridor linking Yichang in Hubei Province and Wanzhou in Chongqing Municipality. Due to the difficult terrain, the YWR has numerous bridges (including two over the Yangtze River) and tunnels—74% of its total length is bridges and tunnels. The government recognized the YWR as the most technically challenging railway project when the YWR was constructed, given the complex topographical, geological, engineering, and hydrogeological conditions.

3. The YWR was designed as a single-track, electrified, standard-gauge, Class I railway that would equally service both freight and passengers, with a project cost of \$2.36 billion. The Board of the Asian Development Bank (ADB) approved a loan for \$500 million on 15 December 2003 to support the project.

### B. Evaluation Purpose and Process

4. The purpose of this project performance evaluation report (PPER) is to assess the project's performance and identify lessons for future projects. The project was evaluated about 5 years after completion, as this timeframe provides adequate time to assess progress in achieving project effectiveness, efficiency, sustainability, and impact. The findings and lessons identified will be useful for designing similar high-speed railway projects in the PRC and other countries.

5. The independent evaluation mission (IEM) was fielded to prepare the PPER in September 2015. The IEM had meetings with the China Railway Corporation (CRC), Wuhan Railway Administration, Chengdu Railway Administration, local governments along the YWR, and other railway-related organizations. The IEM was able to obtain

data on outcomes, outputs, and activities. However, the IEM was not able to discuss in depth project implementation, as the project management office had been dissolved. This meant the PPER depended largely upon the project completion report (PCR) for analysis on the implementation, including safeguards.

# Design and Implementation

## A. Rationale

6. The YWR was designed to provide a new rail link in the national network, connecting Yichang and Wanzhou. The 377 km YWR developed a missing link on one of the main east–west railway routes. The link shortened connections between Shanghai and other economic centers on the east coast and Chongqing and Chengdu in the west. It reduced the travel distance significantly compared with other railway routes and alleviated serious network bottlenecks. In addition, the railway traverses three prefectures in a mountainous region that are less developed because of limited accessibility and expensive motorized transport. The YWR was the first railway line in this poor region, and it constituted a strategic link in the central PRC railway corridor.

## B. Formulation

7. ADB provided project preparatory technical assistance (TA) to review alternative alignments, assess the project’s feasibility, and strengthen arrangements for ensuring compliance with safeguard requirements.<sup>1</sup>

## C. Impacts, Outcomes, and Outputs

8. The envisaged project impact was pro-poor economic growth. The objectives and outcomes were to (i) reduce transport bottlenecks on the national network, increase transport capacity of the corridor, and lower transport costs; and (ii) promote economic growth in the project area. The outputs were (i) constructing 377 km of railway between Yichang and Wanzhou,<sup>2</sup> (ii) track laying and electrification, (iii) constructing freight yards, (iv) installing train control system, (v) constructing new stations and expanding existing stations, (vi) installing equipment for operation, (vii) installing environmental protection facilities, and (viii) institutional strengthening of Ministry of Railways (MOR). There were no baselines or targets. The project design and monitoring framework is in Appendix 1.

## D. Costs and Financing

9. The project cost increased from \$2.364 billion to \$4.125 billion at completion, a 40% increase from the appraisal estimate. The additional cost was due to a government decision in 2006 to double track the 288 km section from Yichang to Liangwu to form part of the Shanghai–Wuhan–Chongqing–Chengdu high-speed railway corridor. The design modification was needed because of the complex topography and geological conditions for construction, upgrades to design standards,

<sup>1</sup> ADB. 2002. *Technical Assistance to the People's Republic of China for Preparing the Yichang–Wanzhou Railway Project*. Manila.

<sup>2</sup> The YWR comprises 324 km in Hubei Province and 53 km in Chongqing Municipality.

and improvements to operational safety standards. Other minor factors that led to a rise in cost were (i) increased land acquisition and resettlement costs because of incremental compensation for building relocation and temporary land use, and relocation of electricity and telecommunication lines; (ii) significantly increased investment for environmental protection; (iii) significantly higher actual costs for administration, consulting services, and miscellaneous expenditures as a result of increased supervision and consulting services; and (iv) higher interest during construction. There was also a substantial appreciation of the yuan against the dollar during implementation.

10. The financing plan envisaged at appraisal included an ADB loan of \$500 million representing 21% of the project cost, a China Development Bank loan of \$725 million representing 31%, and MOR equity inputs of \$1,138 million representing 48%. ADB actually financed \$500 million, representing 12% of the cost. Actual counterpart funds comprised MOR equity investment of \$1,429 million (35% of cost), railway bonds of \$698 million (17%), and China Development Bank loans of \$1,498 million (36%). Project cost and financing plan details are in Appendix 2.

11. The ADB loan proceeds were fully disbursed from July 2004 to December 2011, with \$382.08 million used for civil works, \$27.01 million for equipment, \$87.94 million for materials, \$0.47 million for international consulting services, and \$2.50 million for the front-end fee. The loan closing date was extended from 30 June 2010 to 31 December 2011. The PCR reported that the executing agency applied appropriate disbursement procedures and that ADB's disbursement process was efficient.

12. ADB funded two TA projects during implementation to ensure compliance with its safeguard policy. The first TA was designed to (i) strengthen involuntary resettlement practices; (ii) enhance capacity of the project counterpart institutions, including the local government dealing with the land acquisition and resettlement; (iii) disseminate ADB's resettlement and social safeguard good practices; and (iv) develop a computer-based management information system for resettlement reporting.<sup>3</sup> Under the TA, a resettlement training workshop was conducted for municipal and county resettlement officials in the project area, a computer-based resettlement management information system was established, and two international engineers with expertise in railway tunnels and bridges conducted a structural engineering review to identify technical risk factors. The TA was rated *successful*. The second TA was designed to ensure compliance with ADB's safeguard practices. Consultants carried out an independent review, focusing on the potential disturbance by the project on the Chinese sturgeon breeding grounds and other sensitive species due to bridge construction over the Yangtze. The TA was rated *successful*.<sup>4</sup>

## E. Project Schedule and Implementation Arrangements

13. The project was envisaged to be implemented over 6 years, from 2004 to 2009. Land acquisition and resettlement activities began in late 2003 and were largely completed by the end of 2005. Civil works construction started in January 2004 and was completed in October 2010, 22 months later than forecast at appraisal. Track

<sup>3</sup> ADB. 2002. *Technical Assistance to the People's Republic of China for Strengthening Involuntary Resettlement Practices for the Yichang–Wanzhou Railway Project*. Manila.

<sup>4</sup> ADB. 2006. *Ensuring Safeguard Practices for the Yichang–Wanzhou Railway Project*. Consultant's report. Manila. The panel remarked that, "This all demonstrates that, with adequate care, even a major bridge can 'step lightly' across the natural environment."

laying could not begin until June 2008 because of tunnel construction and was completed in August 2010, 17 months later than scheduled. Equipment installation for telecommunications, signaling, and electrification was completed in October 2010. Trial operation began on 22 December 2010, 1 year later than the original schedule.

14. MOR was the project's executing agency. A project coordination office consisting of key divisions under MOR's steering committee was established to provide guidance during implementation. The Zhengzhou Railway Administration and Chengdu Railway Administration were the implementing agencies until 2007, when the MOR's Railway Construction Management Center started to supervise implementation through the onsite Yichang–Wanzhou Railway Construction Headquarters (YWRCH). The Foreign Capital and Technical Import Center (FCTIC) coordinated the project management office's tasks and was responsible for procuring ADB-financed contracts, withdrawing ADB loan proceeds, and reporting to ADB. The organization chart is in Appendix 3.

15. MOR had lead accountability for land acquisition and resettlement. The institutional responsibility for implementing the resettlement plan rested with the local governments in the provinces, prefectures, and counties traversed by the YWR. The YWRCH's resettlement office had overall responsibility for coordination, fundraising, and internal monitoring and evaluation for land acquisition and resettlement implementation. Railway support offices were established under the Yichang, Enshi, and Wanzhou prefecture and/or municipal governments, which were responsible for implementing land acquisition, house demolition, and relocation. The Fourth Survey and Design Institute of China Railway conducted external monitoring and submitted annual reports to MOR and ADB.

16. The YWRCH was responsible for environmental management and supervision during implementation. Institutional arrangements were established to implement the environmental management plan (EMP), which was part of the project's summary environmental impact assessment and the soil erosion protection plan (SEPP). At the project's beginning, the YWRCH issued the Implementing Rules for Environment Protection and Soil and Water Conservation to regulate and assess the performance of contractors implementing the EMP. Monitoring and mitigation measures were included in the covenants of the civil works contracts. The project engaged local environmental monitoring stations to undertake onsite monitoring of surface water and air quality, as well as noise. The project contracted the Yangtze River Commission's Soil and Water Conservation Monitoring Station to monitor soil erosion as per the SEPP. The Fourth Survey and Design Institute of China Railway served as the environmental supervision engineer to administer EMP and SEPP implementation. The Yangtze Aquatic Institute of the Chinese Academy of Aquatics monitored the impact on Chinese sturgeon from bridge construction over the Yangtze River. During construction, the Beijing OASIS Environmental Protection Technology Company oversaw the overall project environmental monitoring and submitted monitoring reports to MOR and ADB. Contractors and construction supervision companies had designated staff in the site management team to deal with environmental issues.

17. MOR was dissolved and China Railway Corporation (CRC) was established in March 2013. CRC is fully owned by the government, and it succeeded the railway operation from MOR. Under CRC, there are 16 railway bureaus and two railway companies that are responsible for operating and maintaining railways. Among these railway administrations, Wuhan Railway Administration and Chengdu Railway Administration continue to be responsible for operating and maintaining the YWR.

## F. Consultants and Procurement

18. The FCTIC was responsible for procuring ADB-financed contracts. The FCTIC engaged four domestic procurement agents to assist with procurement. In May 2003, ADB approved advance procurement action for civil works. Procurement was initiated in October 2003, and ADB approved the prequalification of contractors in February 2004. Twenty-five civil works contracts were awarded in two batches—in September 2004 (2 months after loan effectiveness) and December 2004 (5 months after loan effectiveness). The advance action was efficiently utilized given the large and complex nature of these contracts. Two packages for track materials (12 contracts) and one package for track maintenance equipment (7 contracts) were procured under ADB loan financing. Because of the substantial increase in metal prices and the appreciation of the yuan against the dollar, the material contracts were significantly higher than estimated, resulting in the ADB loan being insufficient to procure all the planned equipment. As a result, some equipment was procured using counterpart financing. Seventeen civil works contracts and 123 contracts for materials and equipment followed the national competitive bidding process, and these contracts were fully financed by the borrower. All bids were processed on time within the project implementation schedule.

19. The project substantially used national consultant expertise. The project engaged national experts to supervise civil works contracts, as well as electrification and signaling engineering, environmental protection measures, independent monitoring of resettlement implementation, and impacts on Chinese sturgeon habitats and soil erosion. The national experts undertook onsite consultation and diagnosis and held panel meetings on technical issues, all of which contributed to overcoming construction challenges. An international consulting firm was fielded in April 2008, and their services were completed in December 2008. The international consultants delivered a high-technical-quality final report, which detailed the internationally accepted economic and financial appraisal methodologies for the government to follow to improve the feasibility analysis of railway investment projects.

20. Civil works contractors performed well and successfully constructed the tunnels and bridges. With advanced equipment and experienced managers and engineers, these contractors overcame the challenges of complex geological conditions. Many innovative construction methods were used, and quality control was strictly exercised. Risk management was exercised, and systematic measures were taken to ensure worker safety at construction sites. Equipment suppliers also performed well, and all equipment was installed and commissioned as required. The overall performance of consultants, contractors, and suppliers was highly satisfactory.

## G. Safeguards

21. Land acquisition and resettlement activities began in late 2003 and were largely completed by the end of 2005. In total, 15,498 *mu* of land were permanently acquired, which was 5% less than estimated in the resettlement plan.<sup>5</sup> A total of 628,748 square meters (m<sup>2</sup>) of buildings were demolished, 40% more than estimated. The number of displaced persons was 12,336, or 31% less than the estimate. A total of CNY637.48 million of land acquisition and resettlement costs were disbursed, 89% more than estimated. Although the number of people resettled was significantly less than estimated, the costs increased mainly because many affected households had to

<sup>5</sup> A *mu* is a Chinese unit of measurement (1 *mu* = 666.67 square meters [m<sup>2</sup>]).

be resettled in concentrated resettlement sites because of the limited availability of sites due to the mountainous terrain. Increased building demolition, temporary land use, and the relocation of electricity and telecommunication lines also contributed to this cost increase. The YWRCH and railway support offices consulted extensively with local communities and affected people, and worked to solve the issues during implementation and improve affected households' incomes. ADB provided additional resources to strengthen the management of land acquisition and resettlement. The resettlement monitoring completion report indicates affected people's level of production and income is not lower than before land acquisition and resettlement implementation, and that these households have improved living conditions and livelihood opportunities.<sup>6</sup>

22. Ethnic minorities accounted for 39% of the total population in the YWR project area. Tujia is the predominant minority group, accounting for 92% of the total minority population. During YWR construction and resettlement plan implementation, local governments and the YWR Central Headquarters took the following measures to mitigate adverse impacts and ensure minority communities received equal project benefits in a culturally appropriate way: (i) construction of shops close to railway stations to improve the income of minority households affected by land acquisition, (ii) investment in converting sloped land to terraces to increase agricultural output, (iii) engagement of minority laborers as unskilled construction workers for the YWR to increase their incomes, (iv) public investment and railway construction to improve the infrastructure and minority community facilities, and (v) enhancement in minority culture protection and promotion to sustain self-recognition in the region.

23. The EMP and monitoring program were adequately implemented during construction and adverse environmental impacts effectively mitigated. Borrow pits and disposal sites were restored and rehabilitated through retaining structures, drainage systems, and vegetative measures. Cutting surfaces, subgrades, and embankment slopes were generally stabilized through appropriate vegetative and structural measures to prevent soil erosion. Twelve environment monitoring reports were prepared and submitted to ADB, including one summary report for environmental management and one for the Chinese sturgeon conservation program. The monitoring results showed impacts were mitigated. During operation, potential water pollution will be mainly from domestic wastewater from railway stations and living quarters, and partially from wastewater with oil from train maintenance.

24. About 4,170 tons of wastewater is produced daily when the railway and stations are in full operation. Wastewater treatment facilities were constructed following the environmental impact assessment requirements. In particular, the conservation program for the Chinese sturgeon spawning bed performed well. The Yichang Extra-Large Bridge was designed and constructed across the Yangtze River, and disruption of the riverbed and fish population was minimized. Monitoring reports show the Chinese sturgeon population is stable, which indicates mitigation measures were implemented adequately and the project did not negatively impact the Chinese sturgeon's population and spawning habitats.<sup>7</sup>

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<sup>6</sup> The detailed evaluation of land acquisition and resettlement activities is in Appendix 14 of the PCR.

<sup>7</sup> The detailed analysis on environmental impact is in Appendix 15 of the PCR.



## H. Compliance of Loan Covenants

25. The PCR reported that all loan covenants were complied with except the YWR operating ratio. Adequate wagons and locomotives were provided, and specific measures were taken to ensure operational safety. The capacity of connecting lines was significantly expanded 2003–2010 through electrification of existing railway lines and construction of new lines. Container terminals were completed in Chongqing in December 2009, Chengdu in May 2010, and Wuhan in August 2010. The YWR passenger tariff was CNY0.24 per passenger-kilometer (p-km) in 2014. The national freight tariff increased by 30% between 2012 and 2015. The YWR freight tariff is about twice the current national freight tariff. Although the PCR found the YWR operating ratio was not below 75%, the IEM found that ratio was well below 75%. All loan covenants are now complied with (Appendix 4).

# Performance Evaluation

## A. Relevance

26. The YWR was initially proposed in the Tenth Five-Year Plan, 2001–2005 (10th plan) of MOR and was included in the Eleventh Five-Year Plan, 2006–2010 (11th plan), as the government was increasing railway transport capacity to meet economic and social development needs. During 2001–2010, the network for freight increased by 101%, from 1,469 billion ton-km to 2,947 billion ton-km, and for passengers it increased from 477 billion p-km to 961 billion p-km. Despite this growth, railway capacity still seriously lagged behind demand. The government's infrastructure plans prioritized expanding the railway network and constructing new lines in the central and western regions.

27. The 11th plan emphasized railway development, with the construction of 17,000 km of new lines, including railway network expansion in low-income regions. The Twelfth Five-Year Plan, 2011–2015 (12th plan), continued to emphasize building the rail network, prioritizing (i) extending the high-speed rail network to 45,000 km by 2015; (ii) connecting it to every city with a population of at least 500,000; (iii) providing a boost to rail freight as an attractive low-carbon option; and (iv) expanding the network in the central and western regions to narrow development disparities between the central/western and coastal regions. The revised project scopes were also aligned with the 12th plan.

28. ADB's country strategy<sup>8</sup> for the PRC railways during 2004–2006 was designed to improve the access of poor inland provinces to markets for inclusive growth by (i) expanding the railway system by constructing new lines in un-served and less-developed areas, (ii) modernizing and increasing capacity to improve efficiency on national railway system routes, (iii) commercializing railway operations to sustain efficient operations, and (iv) increasing railway competitiveness in the transport sector through restructuring and reform. This strategy remained unchanged at project appraisal and completion.

29. ADB set up the Sustainable Transport Initiative Operational Plan, 2008–2020, focused on developing transport systems that were accessible, affordable, environment-friendly, and safe.<sup>9</sup> Together with the 12th plan's focus on low-carbon transport, ADB's strategy<sup>10</sup> for the PRC during 2011–2015 increased the role of lower carbon and safer transport modes, such as railways. The project was relevant to the recent focus on environment-friendly transport.

30. The YWR was recognized as the most challenging railway project when constructed, given the complex topographical, geological, engineering, and

<sup>8</sup> ADB. 2004. *Country Strategy and Program: The People's Republic of China, 2005–2007*. Manila.

<sup>9</sup> ADB. 2010. *Sustainable Transport Initiative Operational Plan*. Manila.

<sup>10</sup> ADB. 2010. *Country Partnership Strategy: The People's Republic of China, 2011–2015*. Manila.

hydrogeological conditions. Located in the western region of Hubei Province, it passes through the Yungui Highlands at an elevation of 700–1,500 meters (m), as well as the watershed of the Yangtze and Qing rivers. Due to the difficult terrain, the project involved numerous bridges (including two over the Yangtze River) and tunnels—74% of its total length is bridges and tunnels, the highest percentage among the PRC's railways constructed before 2010. Of the 159 tunnels, 32 are longer than 3 km, 3 are longer than 10 km, and the longest one is 13.84 km. There are 253 bridges, the highest of which has 135 m high piers, and the largest concrete span of which is 275 m. Limestone is distributed throughout the entire geological area, and 70% of the route is on karst topography.<sup>11</sup> Faults and folds, underground caves, landslides, underground rivers, methane, and high ground stresses were among the prominent problems encountered. The project design had many innovative features, substantial demonstration value for other projects, and significant transformative outcome.

31. Offsetting these findings, the project design had several weaknesses. The YWR structure gauge permits operation of double-stack container trains to align with the national policy. Double-stack container transport operation on electrified tracks was expected to reduce land use; increase carrying capacity by 60% on the same track; improve energy and environmental efficiency by 40%–60%; and allow cargo to move more quickly, safely, and efficiently. However, double-stack containers had just started to be commercially used for some lines in the PRC, and the YWR tunnels may have been over specified, reducing the efficiency of the design.

32. The most significant design weakness related to expected demand and how the railway design was formulated to meet that demand. The original project design had weaknesses that meant actual freight demand would have been much less than forecasted. If the YWR was not used predominantly for passengers, it would have been unfeasible to increase the freight traffic because of capacity constraints of the adjacent lines. The estimate was also too optimistic that the YWR would get some freight from inland waterways. Luckily, the original concept for the line was changed to focus on passenger traffic. Passenger numbers have far exceeded expectations, and the total YWR usage was not affected by the low usage for freight. If the original design had not been changed, project performance would have been seriously affected by the project design weakness for freight.

33. In conclusion, the project was aligned with the government's development plans and priorities, as well as ADB's strategies, at appraisal and evaluation. Considering the YWR became part of the PRC's Medium- and Long-Term Railway Development Plan to establish a nationwide high-speed railway network, the development of passenger transport on YWR reflects that the strategy is being accomplished. Although the flexible project design change achieved remarkable passenger traffic, there were weaknesses in forecasting freight traffic at appraisal. These weaknesses seriously undermined the original design's feasibility. The project is assessed *relevant*.

## B. Effectiveness

34. The design and monitoring framework set out in the report and recommendation of the President (RRP) did not provide either targets or baselines that could be used to evaluate effectiveness. As a result, the evaluation based its analysis of

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<sup>11</sup> Karst refers to porous limestone containing deep fissures and sinkholes and characterized by underground caves and streams.

effectiveness on the extent the expected traffic in passengers and freight and their attendant outcomes at appraisal were achieved.

35. YWR passenger traffic in 2011, the first full year of operation, was 10.5 million—30% above the forecast at appraisal. Passenger numbers doubled to 21.1 million in 2014, third year after the full operation year. This result was double the appraisal projections following the introduction of new and faster high-speed trains (HSTs)<sup>12</sup> in July 2013 and the opening of high-speed passenger dedicated lines between Wuhan and Yichang in July 2012, and between Lichuan and Chongqing in July 2013. Given the trends in the first half of 2015, the passenger number was expected to be more than 25 million in 2015, which will be 2.5 times higher than the appraisal and 40% higher than estimated in the PCR. The YWR's about 21 million passengers in 2014 substantially exceeded the about 10 million passengers a year on Eurostar between London and Paris/Brussels, a major high-speed railway corridor in Europe. The YWR's high level of passenger density (passengers per km) also supports that the YWR infrastructure is effectively used.<sup>13</sup> Major events that have affected the YWR's traffic growth and estimates are shown in Appendix 5.

36. Freight traffic is only 5% of original projections on the double-track section, and there are no freight services on the single-track section. Reasons for the less-than-expected freight traffic include (i) the priority being given to the high-speed corridor for passengers between Shanghai and Chengdu, and long-distance transit freight no longer being within the YWR's business scope; (ii) capacity constraints on adjacent lines that feed traffic on to the YWR;<sup>14</sup> (iii) the existence of a direct East–West alternative rail route to the north of the YWR; and (iv) the greater efficiency of inland waterways once the Three Gorges reservoir filled and a port-rail connection opened in Wanzhou in 2010. At Wanzhou, traffic transfers between ship (to/from the East) and rail (to/from the West), thereby diverting it from the YWR.

37. The travel time on the YWR from Yichang to Enshi was shortened to 2.5 hours from 9–10 hours by bus before the expressway was opened, and from 3.5 hours by bus after the expressway was opened. The benefits of the high-speed railway corridor are more significant. The travel time from Wuhan to Chongqing using the YWR was shortened to 6.5 hours from 22 hours by bus before the expressway was opened, and from 13 hours by bus after the expressway was opened. In addition to faster travel times, YWR rail fares are 70%–80% cheaper than bus fares. The parallel Yichang–Wanzhou Expressway, a section of the national trunk highway between Shanghai and Chengdu, has a high toll level, speed limits for tunnels, continuous long slopes with high gradients, and interruptions because of bad weather. The YWR demonstrates obvious competitive advantages over other transport modes because of its low cost, shorter travel time, better safety, and more reliable performance.

38. Although passenger traffic is highly successful, the project is considered *effective* in achieving outcomes and outputs because (i) the RRP did not have targets or

<sup>12</sup> CRC introduced electrical multiple units for the HSTs, which require no separate locomotive, as electric traction motors are incorporated within one or several cars.

<sup>13</sup> Passenger density is an indicator to show to what extent railway infrastructure is used. Passenger density is ideally measured by p-km per km of operation, but p-km for the YWR is not available. Thus, the number of passengers is used here for the indicator. This measure is biased towards short-distance railways. The YWR's passenger density in 2014 was 60,000, which exceeded the 43,000 of Japan's *Joetsu Shinkansen* (high-speed railway) in 2014. The railway runs almost the same distance as the YWR, with 333 km connecting Tokyo and Nigata (north from Tokyo).

<sup>14</sup> Yichang–Yaqueling, Jinmen–Changjiangfu, Dazhou–Wanzhou, and Wuhan–Macheng are single-track lines and have reached nearly full capacity usage.

baselines that could be used to evaluate effectiveness and (ii) freight traffic is much less than the original estimate.

### C. Efficiency

39. This PPER recalculated the economic internal rate of return (EIRR) at 14.1%, which was slightly less than estimated at appraisal (14.5%) and in the PCR (15.6%). In recalculating the EIRR, the PPER undertook with- and without-project scenarios and quantified (i) time- and operating cost-saving benefits of passengers, (ii) operating cost-saving benefits of freight traffic, and (iii) tourism benefits attributable to the YWR. Passenger traffic benefits were the major source of economic benefits (71%), followed by benefits from tourism not included in transport benefits (28%), and those from freight traffic (1%). Traffic-generated benefits were included in the RRP, and both environmental and safety benefits and network benefits were included in the PCR. But these benefits were not quantified in the PPER, as data to calculate these benefits was not readily available without a large-scale survey. Other economic development benefits were identified in the western PRC. The detailed methodology of reevaluating the EIRR is in Appendix 6.

40. The recalculated EIRR exceeds the cut-off rate of 12%, and it is concluded the project is economically viable and is assessed *efficient*.

### D. Sustainability

41. The PPER estimated an after-tax financial internal rate of return (FIRR) of 5.7%, which is higher than the weighted average cost of capital of 2.5%, and therefore the project is considered financially viable. Capital cost was based on actual expenditure incurred for the project. Project revenues consisted of passenger, freight, and other transport-related revenues. These definitions are the same as those figures presented in the RRP and PCR. All revenues and expenses for the financial reevaluation were expressed in 2014 prices. The detailed methodology to recalculate the FIRR is in Appendix 6.

42. The project is calculated to have produced a small positive cash flow for the first time in 2012. Its revenue will cover the operation and maintenance cost and depreciation after 2015, and the operation and maintenance cost, depreciation, and interest after 2018. CRC is expected to ensure funding for the YWR that is sourced from its own revenues.<sup>15</sup> If CRC is not financially viable and is unable to service its debt, it is assumed the government (as sole owner of CRC) would increase its equity and/or allow a higher tariff, since railways in the PRC are considered a public service. Base freight tariffs have also increased from CNY0.115 in 2012 to CNY0.155 in 2015, an increase of 35%, well above inflation. Financial analysis of the whole CRC network is beyond the PPER's scope, since the YWR line is less than 0.3% of the national network.

<sup>15</sup> A study on financial assessment of high-speed rails in the PRC explains that 250 km/h high-speed railway lines with 25 million–30 million passenger trips per year are estimated at a threshold to be commercially viable. The capital cost of the 250 km/h high-speed railway lines is \$11 million–\$25 million per km, according to the study, and that of the YWR is \$10 million per km (underestimated since the calculation includes the single track). Since YWR passenger trips are estimated at 33 million in 2018, the PPER's conclusion is also supported by the study. (Wu Jianhong. 2013. Financial and Economic Assessment of China's High Speed Rail Investments. Discussion Paper 2013–28. OECD: Paris).

43. Responsibility for YWR operation has been assigned to the Wuhan Railway Administration for the Yichang–Liangwu section, and to the Chengdu Railway Administration for the Liangwu–Wanzhou section. These railway administrations have extensive experience of operating railways. Public safety campaigns were conducted to familiarize the local people with safety issues, including crossing the railway line safely, and the local governments established offices to assist safety efforts. The institutional framework works well for operations and maintenance, as shown by the punctuality of passenger train services (90% on time) and reasonable safety records (no fatal accidents up to August 2015). It also works well for planning in coordination with local governments. These capabilities indicate a high level of institutional sustainability.

44. The project produced environmental benefits by transferring traffic from roads and aircrafts on to an electrified railway. Considerable emphasis was also placed on protecting the environment because of the region’s sensitivity. The project design included features to mitigate negative environmental effects. Environmental bureaus of local governments explained to the IEM that environmental protection was well managed during project implementation and after completion. For example, one major environmental issue was how to handle soil disposal, and it was carefully managed, with half being allocated to protected sites and the rest used for farming.

45. The PPER rates the project *likely sustainable* based on acceptable financial returns, good operation and maintenance practices, a sound institutional framework, and good environmental and safety practices. In addition, since railways are an energy-efficient mode of transport, the project will continue to contribute to the reduction of carbon dioxide emissions.

## E. Overall Assessment

46. The project is assessed *relevant, effective, efficient, and likely sustainable*. The project was successfully implemented despite being the most challenging railway project in the PRC to date. It achieved its main objectives of increasing corridor capacity, removing transport barriers, and reducing transport and logistics costs. The project contributed to economic growth and poverty reduction in the project area and potentially in the western PRC. The reevaluated EIRR of 14.1% and FIRR of 5.7% confirm the project’s economic viability and financial sustainability. Overall, the project is rated *successful* (Table).

**Overall Performance Assessment**

Criteria	Weight (%)	Rating	Rating Value	Weighted Rating
Relevance	25	Relevant	2	0.5
Effectiveness	25	Effective	2	0.5
Efficiency	25	Efficient	2	0.5
Sustainability	25	Likely	2	0.5
<b>Overall Rating</b>		<b>Successful</b>		<b>2.0</b>

Source: Asian Development Bank Independent Evaluation Department.

## CHAPTER 4

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# Other Assessments

### A. Impact

47. As no targets were presented in the loan documents, the PPER evaluated impact on a qualitative basis looking at actual impacts, rather than those envisaged in the RRP.

48. The project provided employment during construction, amounting to about 800,000 person-days, about half of which was for local laborers from poor households.<sup>16</sup> It now provides more than 3,000 permanent jobs for YWR operations and maintenance. Many surplus rural laborers work outside the region, and most of them return home during the Spring Festival each year. The railway improved local mobility and consequently improved job opportunities inside and outside the project area. The poverty incidence in areas along the YWR decreased from 18.6% to 5.8% from 2002 to 2010.<sup>17</sup>

49. The YWR construction and operation promoted gender development in the project area. Many YWR laborers were women, typically engaged in cleaning and maintaining trucks and other equipment, cooking for construction teams, and doing sanitation work at the construction sites. Female employees received wages equivalent to those of male employees for similar job types. The YWR facilitated rapid improvement in local socioeconomic conditions, and increasing numbers of girls and women working in nearby enterprises. In addition, rail travel enabled women to be engaged as migrant laborers and increase their income.

50. The prefectures along the YWR experienced high growth in gross domestic product (GDP) during the construction period and after the YWR's opening. During the construction period, from 2002 to 2010, GDP in these prefectures grew 108%–299%. After YWR operation, from 2010 to 2014, GDP grew by 102% in Yichang Prefecture, 74% in Enshi Prefecture, and 54% in Wanzhou Prefecture, while national GDP grew by 56%. The two prefectures along the high-speed railway corridor (Yichang and Enshi) achieved higher economic growth than national average. Not all of this growth can be attributed to the YWR, as a parallel expressway was opened in 2009 and some growth would have occurred without either facility.

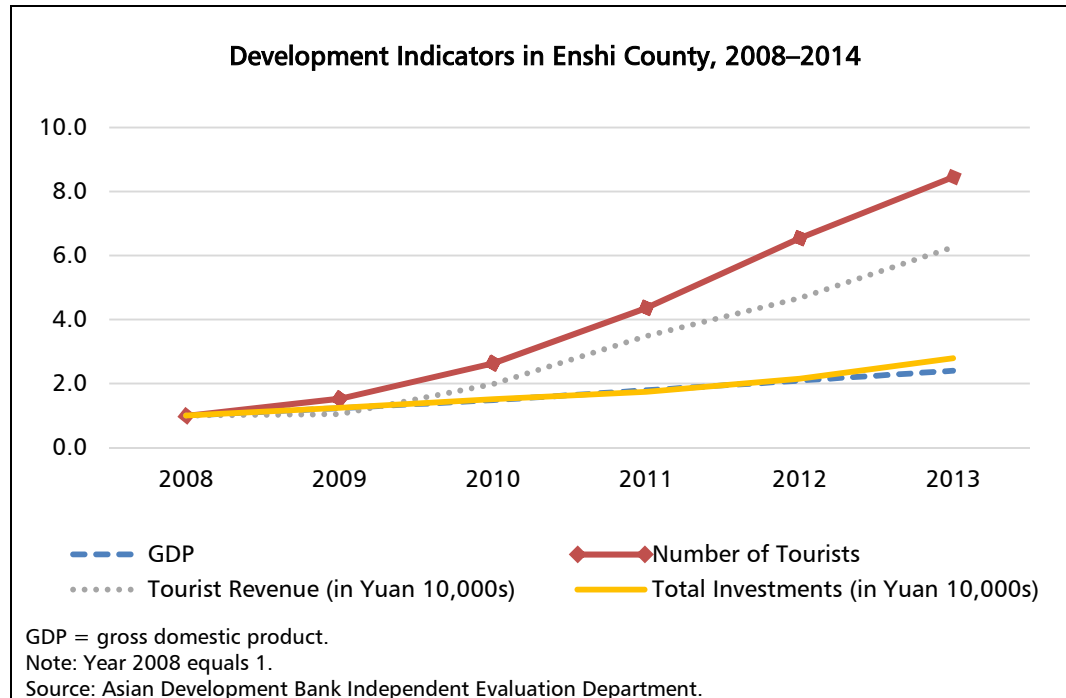
51. Despite the decision to prioritize corridor use for long-distance, high-speed passenger services, the proportion of passengers that have either origin or destination on the line remains 40%, as estimated in the feasibility study. This meant the socioeconomic impact after YWR operation was relevant to the areas along the YWR. The project area is rich in tourism resources. In Enshi Prefecture, tourism is the main

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<sup>16</sup> ADB. 2012. *Project Completion Report: Yichang-Wanzhou Railway Project (People's Republic of China)*. Manila.

<sup>17</sup> Footnote 16. Comparison of the poverty incidence after 2011 was not possible, since the definition of the poverty incidence was changed.

industry, and the increased numbers of tourists should bring significant benefits. Although only 20%–40% of tourists visit Enshi Prefecture by railways (most other tourists used the expressway parallel to the YWR), some are reported to come by road or air and then use railways to travel around the area. The following chart shows the trend in economic indicators for Enshi County, adjacent to Enshi Station, which is in the middle of the YWR and the largest intermediate station. For most indicators, especially those related to tourism (which increased dramatically), growth accelerated in Enshi County after the line was opened in December 2010.



52. The impact of the project extended to a wider area, notably Yichang. The high-speed rail corridor contributed to the creation of a transport hub in Yichang City, which is rapidly expanding as one of the region's leading centers. The Yichang Prefecture government is constructing a new city district, the center of which is Yichang East Station.

53. As a result of the strategy switch to develop the corridor more for passengers, especially long-distance ones, and less for freight, both the nature of benefits and the beneficiaries changed from those envisaged at appraisal. Since the YWR is part of the rail passenger corridor linking the PRC's west and east, the project will contribute to the socioeconomic development of a much wider area of the PRC, especially to the west of the line. About 60% of YWR passengers are through passengers (they do not use YWR stations), so more than half the benefits are estimated to go to through passengers from areas such as Sichuan Province and Chongqing Municipality.

54. Since the project is likely to have substantial positive development impacts and there were no reported significant negative effects, it is assessed *significant*. The project appears to have had an impact on socioeconomic development of poor provinces, in which the project is mainly located, and probably in poorer provinces to the west. Although the project is presumed to have highly significant impact, there was



no target to judge the impact against and there is no proof as to what extent the project contributed to pro-poor economic growth. The PPER assessed the project *significant*, as the PCR and project validation report did.

## B. Performance of the Borrower and the Executing Agency

55. MOR addressed the major technical and engineering challenges of constructing railways in mountainous regions and was flexible to change the design for double tracking. It mobilized the resources of design institutes, contractors, supervision engineers, and foreign and national experts to tackle the difficulties of constructing complex tunnels and bridges. Recognizing that high levels of new engineering methods and advanced technologies needed to be introduced, MOR set up the Railway Construction Management Center at the headquarters in Beijing to integrate all available in-country, high-level resources and supervise the YWRCH. Many best practices were introduced to improve and modernize the construction method. For example, for the first time in the railway subsector, a risk management system was introduced in project management.

56. MOR mitigated environmental risks and complied with ADB's safeguard policies. The local governments established liaison railway offices to coordinate with YWRCH. The design reduced environmental disturbance, improved the capacity for water and soil conservation, and increased the ability to resist natural hazards and the level of operational safety.

57. The main areas of weakness were apparent in the project preparation stage, when it committed to a project design that was not feasible, and in the implementation stage, when a new concept was introduced without updated assessment of the project's feasibility. This change in scope introduced a high level of project risk, compounded by the absence of a monitoring system to measure performance against targets. Overall, the performance of the borrower and MOR was *satisfactory*.

## C. Performance of the Asian Development Bank

58. ADB's performance was *satisfactory*. The processing team included social dimensions in the project, incorporated rigorous safeguard monitoring arrangements, assessed major risks, and designed appropriate loan covenants. During implementation, procurement was processed efficiently, and the loan proceeds were disbursed in a timely manner. Eight review missions, including a midterm review, were fielded during implementation. The review missions and ADB's frequent communications with MOR resolved problems encountered.

59. According to the PCR, MOR expressed appreciation for ADB's efficiency in procurement and disbursement and in resolving implementation issues. ADB effectively strengthened the safeguards supervision during implementation. The resettlement database system provided useful information for resettlement management, and benefited other projects through experience learning and system replication. ADB closely monitored the project impact during construction as well as the railway's impact on the local economy beyond project completion.

60. Similar to the government, the most important shortfalls occurred in the project preparatory phase, as due diligence was weak and there were no targets to

monitor and measure performance. In many respects, there appears to have been a high degree of luck attached to this project, in which a major change of scope was required after implementation, to enable it to achieve economic and financial viability. The growth in passenger numbers that far exceeded forecasts indicates that such a positive outcome was not envisaged at appraisal.

## CHAPTER 5

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# Issues, Lessons, and Follow-Up Actions

### A. Issues and Lessons

61. It is recommended that use of the line's single-track section be reviewed. There is no passenger railway station between Lichuan and Wanzhou although the section is 89 km long. Eight pairs of trains per day are operated on the single-track section against a maximum capacity of 12 pairs of trains. As there is still capacity to increase the number of trains, a feasibility study is recommended to determine how best to use this capacity. This analysis should include the option of opening passenger railway stations in the section, as this would bring benefits to local people. A request has already been submitted to the Chengdu Railway Administration to build a passenger station at Luo Tian, which could serve an area with a population of 200,000 that has poor road connections.

62. Changyang Station, 62 km west from Yichang East Station, is located in Changyang Tuji Autonomous County under the Yichang Prefecture. HSTs are unable to stop at the station since the platform is 250 m long, 150 m short of accommodating HSTs. HST stops at the station will increase benefits of people in the minority county, with a population of about 400,000. The Yichang Prefecture Government submitted a request to CRC to increase the platform's length. A feasibility study is recommended to decide whether the station's capacity improvement is acceptable, balancing the benefits for transit passengers and local people.

63. The Yichang–Yaqueling Railway (YYR) is a single-track, electrified railway line connecting the YWR at the west end. YWR freight trains should use the YYR to go north, east, or south, since Yichang–Wuhan Railway is a passenger-dedicated line. However, the YYR already uses 92% of its capacity, and there is not enough spare capacity to accommodate freight trains. If the YWR increases freight trains that go north, east, or south through Yichang, the YYR needs to increase its capacity by double tracking. The single-track, electrified Jinmen–Changjiangfu Railway is part of the Wuhan–Yichang freight corridor, but the railway uses 90% of its capacity and needs to be double-tracked to accommodate the YWR's potential extra freight trains. While the YWR is predominantly used for passenger trains and has only limited spare capacity at night for freight trains, some additional trains may be needed in the future to capture local freight traffic needs and help develop the local area. The YYR will be double-tracked by 2018, but feasibility studies of increasing capacities of other adjacent lines are recommended. Future railway planning needs to analyze the capacity of other railway lines that affect the project line. Planning should also note that although many PRC passenger trains still have to share heavily used tracks with freight trains, resulting in compromised speed and capacity, the rapidly expanding railway network will

gradually enable separation of passenger and freight operation to achieve higher efficiency.

64. It was assumed at appraisal that traffic from inland waterways and other railways would shift to the YWR, but this has not happened. In future railway planning, given increasing competitiveness of inland waterways this decade, intermodal transport combining railways and inland waterways needs to be considered.

65. The YWR was designed to accommodate double-stack container trains, and this has major implications for tunnels, which were all constructed to meet this requirement. Accommodating double-stack containers is a national standard for new railway lines, but double-stack containers have just started to be used in limited lines in the PRC. Given the small quantity of freight traffic on the YWR, double-stack containers are unlikely to be used for the time being. Although this is not a project-level issue, there is a need to review whether this requirement is applied to all new railway lines, or to follow-up the future utilization plan for double-stack containers.

## B. Follow-Up Actions

66. The PPER found that no follow-up actions on the project are needed. All covenants are complied with. CRC is expected to ensure appropriate maintenance and rehabilitation of the line, and the government is expected to provide overall funding for CRC through tariff increases or equity injections.

# Appendixes

## APPENDIX 1: PROJECT DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Indicators	Project Achievements (as in PCR)	PPER Update	Assessment
<b>Impact</b> Pro-poor economic growth	Major socioeconomic indicators	GDP grew 108%–299% in project areas from 2002 to 2010.	GDP grew by 102% in Yichang Prefecture, 74% in Enshi Prefecture, and 54% in Wanzhou Prefecture from 2010 to 2014, while national GDP grew by 56%.	No targets were given at appraisal. However, substantial impacts were observed in the project area. An expressway parallel to the YWR also contributed to pro-poor economic growth in the project area.
	Growth of local economy	Per capita GDP grew 266%–446% in project counties from 2002 to 2010. Per capita rural income increased from CNY1,210–CNY4,027 in 2002 to CNY3,243–CNY6,990 in 2010.	Per capita GDP grew by 69% in Yichang Prefecture, 97% in Enshi Prefecture, and 71% in Wanzhou Prefecture from 2010 to 2014, while national per capita GDP grew by 53%.	Since the YWR became part of the Shanghai–Wuhan–Chongqing–Chengdu high-speed railway corridor, socioeconomic impacts were created in a much wider area, including the PRC’s poor western areas. About 60% of YWR passengers are transit passengers who do not use stations on the YWR.
	Poor population	Poverty incidence decreased by 5.80–18.58 percentage points from 2002 to 2010.	Comparison of poverty incidence is not available since definition of poverty was changed.	
	Change of quality of life for project-area population	Quality of life improved significantly as measured by major welfare indicators for medical condition, education, roads, and telecommunications, as well as broadcast coverage.		
<b>Outcomes</b> Promote economic growth in the project area	Direct and indirect employment provided	790,830 person-days of employment were provided during construction; 193 local laborers were recruited for YWR operation.	The YWR provides more than 3,000 permanent jobs for its operation and maintenance.	No targets were given at appraisal. However, high economic growth was achieved in the project area.

Design Summary	Performance Indicators	Project Achievements (as in PCR)	PPER Update	Assessment
Reduce transport bottlenecks on the national network, increase transport capacity of the corridor, and lower transport costs	Production of local goods increased	493 enterprises with CNY9.7 billion in investments were established 2006–2010.	Investments doubled in Enshi Prefecture from 2010 to 2013  The number of tourists in Yichang Prefecture increased 3.4 times from 12.1 million in 2009 to 40.9 million in 2014. The number of tourists in Enshi Prefecture increased 4.0 times from 6.6 million in 2009 to 26.5 million in 2013.	Substantially higher than estimates at appraisal. Reduced the bottleneck in the mountainous area and increased transport capacity of one of the PRC's most important high-speed railway corridors. Passenger transport volume per km achieved world top class. Freight transport became less important for the YWR due to strategic shift to passenger transport. Transport costs were significantly reduced. Rail fares are 70–80% cheaper than bus fares.
	Volume of traffic increased	Passenger volume increased from about 12.26 million passengers in 2011 to 18.05 million in 2015 and 28.11 million in 2025. Freight traffic grew from 0.59 million tons in 2011 to 5.15 million in 2015 and 18.45 million in 2025.	Passenger volume increased from 10.5 million passengers in 2011 to 21.1 million passengers (2.2 times of expected passengers at appraisal) in 2014. Passengers are expected to number more than 25 million in 2015 (passengers who used the Yichang East Station or the Wanzhou Station but did not use the YWR are excluded in these numbers, although these stations are within the scope of the project). Freight traffic was 0.6 million tons (5% of expected tons at appraisal) in 2011 and 0.7 million tons in 2014. The PPER estimated it will increase by 0.6 million tons by 2025. The appraisal estimate of freight traffic will never be realized.	
	Access to wider markets provided	YWR operation directly increased the competition among local forwarders and wholesalers, reduced the prices of commodities, and improved living standards for local people, particularly the poor.	About 14 million people used YWR stations in 2014 (passengers who used the Yichang East Station or the Wanzhou Station but did not use the YWR are included in this number).	

Design Summary	Performance Indicators	Project Achievements (as in PCR)	PPER Update	Assessment
	<p>Complementary roads developed in the project area</p> <p>Operating efficiency of the railway system in the east-west corridor improved</p> <p>Transport costs reduced</p>	<p>More than 600 km of constructed access roads were handed over to local governments and became the main roads in remote mountainous areas benefiting local communities. All villages had road access in 2010.</p> <p>Per day locomotive productivity increased by 22.0% from 2005 to 2010, and turnover days for wagons decreased by 9.8% from 4.92 days to 4.48 days. Labor productivity, excluding price impact, improved by 35.0% over the same period.</p> <p>Travel costs fell from CNY0.53/km to CNY0.15/km for passengers and from CNY0.85/km to CNY0.22/km for freight transport.</p>	<p>Travel costs fell from CNY0.53/km to CNY0.24/km for passengers and from CNY0.85/km to CNY0.30/km for freight transport.</p>	
<p><b>Outputs</b></p> <p>1. 377 km of railway constructed between Yichang and Wanzhou</p>	<p>Final bill of quantity against original bill of quantity</p> <p>Contract variations</p> <p>Physical completion date</p> <p>Final acceptance of the facilities by MOR</p>	<p>YWR is fully operational for passenger and freight transport.</p> <p>Physical completion achieved on 22 December 2010. The final acceptance is not yet conducted.</p> <p>377 km long electrified, standard-gauge, class 1 railway, of which 288 km is double track and 89 km is single track, completed.</p>	<p>The YWR's double-track section is fully operational as part of the Shanghai–Wuhan–Chongqing–Chengdu high-speed passenger railway corridor. The YWR's single-track section is fully operational for passenger and freight transport, but freight trains are not operated due to lack of demand.</p>	<p>Achieved.</p>



Design Summary	Performance Indicators	Project Achievements (as in PCR)	PPER Update	Assessment
2. Track laying and electrification	Tracks with rails, sleepers, ballast, associated fittings and fixings; 14 traction substations, one power supply station, and power lines	Rails, accessories, concrete sleepers, and stone ballast fully installed. 13 traction substations and 923 km of catenary line installed. The power supply station was not needed.		Achieved.
3. Freight yards constructed	Freight yards and associated facilities	Established in 12 railway stations.		Achieved.
4. Train control system installed	A train control system	Equipment for telecommunication, signaling, and traffic control system installed. A centralized train control system was established and is operating; command is provided in Wuhan Railway Administration and Chengdu Railway Administration.		Achieved.
5. New stations constructed and existing stations expanded		10 new railway stations constructed; existing Yichang Station and Wanzhou Station expanded.	Seven new passenger stations constructed; existing Yichang Station and Wanzhou Station expanded. Four new maintenance stations constructed.	Achieved.
6. Equipment for operation installed	Supply of operation and maintenance equipment for signaling and communication, electrical facilities, transportation and financial information system, freight and container yard operation, and maintenance of tracks, tunnels, and bridges	Sufficient operation and maintenance equipment, including rolling stock, provided by Wuhan Railway Administration and Chengdu Railway Administration.	Double-track section operated by Wuhan Railway Administration and single-track section operated by Chengdu Railway Administration.	Achieved.

Design Summary	Performance Indicators	Project Achievements (as in PCR)	PPER Update	Assessment
7. Environmental protection facilities installed	Supply of equipment and facilities for environmental mitigation and protection	Wastewater treatment facilities and sound barriers installed. Solar or electric heaters adopted. Use of ballastless embankments, seamless track, and shock absorbers on bridges over Yangtze River reduced adverse impact during operation.		Achieved.
8. Institutional strengthening of MOR	Institutional strengthening performance, to be assessed by MOR and ADB against standards	International consulting firm engaged to develop the Guidelines for the Appraisal of Railway Investment Projects; training provided for application of guidelines.		Achieved.
<b>Activities/Inputs</b> Construction of the project railway (including construction of service roads and station access roads)	Construction progress, actual performance against PAM	377 km main line constructed.  600 km access roads constructed.		Achieved.
Land acquisition and resettlement	Actual performance against resettlement plan; grievances, disputes, and complaints	15,498 <i>mu</i> <sup>3</sup> of land permanently acquired, 5% less than the resettlement plan estimate; 628,748 m <sup>2</sup> of buildings demolished, 40% more than estimate; 12,336 persons displaced, 31% less than estimate; CNY637.48 million of land acquisition and resettlement costs disbursed, 89% higher than estimate.		
Civil works and procurement of materials, equipment, and locomotives	Tendering quality of service; responsiveness to ADB requirements;	Civil works included 25 ICB contracts and 17 NCB contracts; 12 contracts for track materials and 7 contracts for track		

Design Summary	Performance Indicators	Project Achievements (as in PCR)	PPER Update	Assessment
	quality of specifications of the bidding documents	maintenance equipment procured with ADB financing; 17 civil works contracts and 123 contracts for materials and equipment fully financed by the borrower. Rolling stock provided by MOR separately from the project.		
Consulting services for construction supervision, environmental supervision, tendering, quality assurance, and monitoring	Construction quality; supervision quality	10 national supervision companies and five consulting firms or institutes engaged for the supervision of civil works, environmental protection, and monitoring of resettlement implementation. An international consultant reviewed compliance with ADB's safeguard policy, particularly the mitigation measures for the Yangtze River's endangered species.		
Implementation of environmental impact mitigation measures in project design and construction	Mitigation measures from the environmental impact assessment and environmental management plan	26 borrow pits and 197 disposal sites employed and adequately restored and rehabilitated. Domestic solid wastes from stations during operation collected and disposed of following domestic regulations. Wastewater treatment facilities operated in all stations. Soil erosion protection plan and Chinese sturgeon conservation programs implemented effectively.	The surplus soil was carefully handled with half in protected sites and the rest used for farming.	

ADB = Asian Development Bank, GDP = gross domestic product, ICB = international competitive bidding, km = kilometer, m<sup>2</sup> = square meter, MOR = Ministry of Railways, NCB = national competitive bidding, PAM = project administration manual, PCR = project completion report, PPER = project performance evaluation report, PRC = People's Republic of China, YWR = Yichang–Wanzhou Railway.

<sup>a</sup> A *mu* is a Chinese unit of measurement (1 *mu* = 666.67 m<sup>2</sup>).

Source: Asian Development Bank.

## APPENDIX 2: PROJECT COST AND FINANCING PLAN

**Table A2.1: Project Costs**  
(\$ million)

Item	At Appraisal			At Completion		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
<b>A. Base Cost</b>						
1. Civil Works	787.20	849.10	1,636.30	443.73	2,510.03	2,953.76
2. Railway Materials	45.80	34.40	80.20	93.39	118.57	211.96
3. Signaling, Communications, MIS	17.80	21.30	39.10	0.00	94.71	94.71
4. Electric Power and Electrification	17.50	58.70	76.20	0.00	182.36	182.36
5. Operational, Safety, and Maintenance Equipment	41.00	12.20	53.20	33.56	34.74	68.30
6. Land Acquisition and Resettlement	0.00	42.00	42.00	0.00	95.67	95.67
7. Environmental Protection, Mitigation, and Monitoring <sup>a</sup>	0.90	3.00	3.90	0.00	18.06	18.06
8. Administration, Consulting Services, and Miscellaneous Costs	1.30	32.00	33.30	0.58	207.00	207.58
<b>Subtotal (A)</b>	<b>911.50</b>	<b>1,052.70</b>	<b>1,964.20</b>	<b>571.26</b>	<b>3,261.14</b>	<b>3,832.40</b>
<b>B. Contingencies</b>						
1. Physical Contingencies	77.30	79.60	156.90	0.00	0.00	0.00
2. Price Contingencies	32.30	37.30	69.60	0.00	0.00	0.00
<b>Subtotal (B)</b>	<b>109.60</b>	<b>116.90</b>	<b>226.50</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
<b>C. Front-End Fee</b>	<b>2.50</b>	<b>0.00</b>	<b>2.50</b>	<b>2.50</b>	<b>0.00</b>	<b>2.50</b>
<b>D. Interest during Construction and Commitment Charge</b>	<b>61.80</b>	<b>108.50</b>	<b>170.30</b>	<b>0.00</b>	<b>290.19</b>	<b>290.19</b>
<b>Total</b>	<b>1,085.40</b>	<b>1,278.10</b>	<b>2,363.50</b>	<b>573.76</b>	<b>3,551.32</b>	<b>4,125.09</b>

MIS = management information system.

<sup>a</sup> Cost for slope stabilization, ecological rehabilitation, embankment protection, and spoil revegetation is included in the cost of civil works.

Sources: Asian Development Bank and the Ministry of Railways.

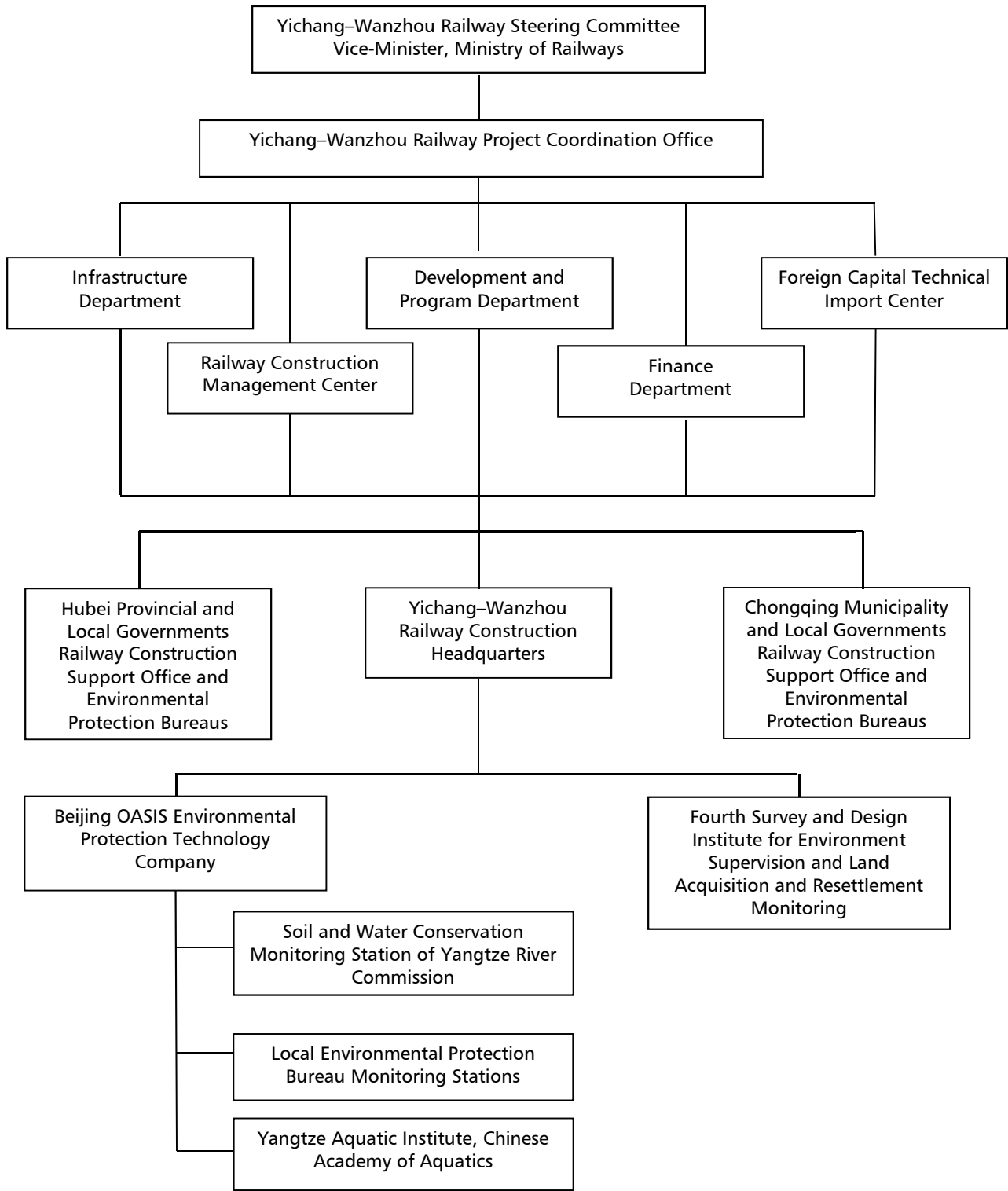
**Table A2.2: Financing Plan**  
(\$ million)

Source	At Appraisal			At Completion		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
Asian Development Bank	500.00	0.00	500.00	500.00	0.00	500.00
China Development Bank	0.00	725.00	725.00	0.00	1,498.42	1,498.42
Ministry of Railways	585.00	553.00	1,138.00	73.76	2,052.91	2,126.67
<b>Total</b>	<b>1,085.00</b>	<b>1,278.00</b>	<b>2,363.00</b>	<b>573.76</b>	<b>3,551.32</b>	<b>4,125.09</b>

Note: Decimal figures may not add up due to rounding.

Sources: Asian Development Bank, the Government of the People's Republic of China, and the Ministry of Railways.

## APPENDIX 3: ORGANIZATION CHART FOR YICHANG–WANZHOU RAILWAY PROJECT DURING PROJECT IMPLEMENTATION



Source: Asian Development Bank.

## APPENDIX 4: COMPLIANCE WITH LOAN COVENANTS

Covenants	Reference	Status of Compliance
<p>1. (a) The Borrower shall cause the Project to be carried out with due diligence and efficiency and in conformity with sound administrative, financial, engineering, environmental, and railway practices.</p> <p>(b) In the carrying out of the Project and operation of the Project facilities, the Borrower shall perform, or cause to be performed, all obligations set forth in Schedule 6 to this Loan Agreement.</p>	<p>Loan Agreement, Article IV 4.01</p>	<p>Complied with. The project was designed following relevant standards of the railway sector.</p>
<p>2. The Borrower shall make available, promptly as needed, the funds, facilities, services, land, and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the Project and for the operation and maintenance of the Project facilities.</p>	<p>Loan Agreement, Article IV 4.02</p>	<p>Complied with. Counterpart funds were provided in a timely manner.</p>
<p>3. (a) In the carrying out of the Project, the Borrower shall cause competent and qualified consultants and contractors, acceptable to ADB, to be employed to an extent and upon terms and conditions satisfactory to the Borrower and ADB.</p> <p>(b) The Borrower shall cause the Project to be carried out in accordance with plans, design standards, specifications, work schedules and construction methods acceptable to ADB. The Borrowers shall furnish, or cause to be furnished, to ADB, promptly after their preparation, such plans, design standards, specifications and work schedules, and any material modifications subsequently made therein, in such detail as ADB shall reasonably request.</p>	<p>Loan Agreement, Article IV 4.03</p>	<p>Complied with. All ADB-financed contracts were reviewed and approved by ADB. Information requested by ADB was provided satisfactorily.</p>
<p>4. The Borrower shall ensure that the activities of its departments and agencies with respect to the carrying out of the Project and operation of the Project facilities are conducted and coordinated in accordance with sound administrative policies and procedures.</p>	<p>Loan Agreement, Article IV 4.04</p>	<p>Complied with. The institutional arrangements for project implementation were effective.</p>
<p>5. The Borrower shall enable ADB's representatives to inspect the Project, the goods financed out of the proceeds of the Loan, and any relevant records and documents.</p>	<p>Loan Agreement, Article IV 4.06</p>	<p>Complied with. ADB reviewed the project annually.</p>
<p>6. The Borrower shall ensure through MOR that the Project facilities are operated, maintained and repaired in accordance with sound administrative, financial, engineering, environmental, railway construction, and maintenance and operational practices.</p>	<p>Loan Agreement, Article IV 4.07</p>	<p>Complied with. Operation of the project railway was assigned to Wuhan and Chengdu railway administration bureaus, which follow uniform operation and maintenance requirements of the sector.</p>

Covenants	Reference	Status of Compliance
7. <b>Implementation Arrangements.</b> MOR shall be the Executing Agency for the Project, responsible for overall implementation of the Project and assume the responsibility under the Project-related agreements. The steering committee established by MOR shall provide overall guidance for Project implementation. The project coordination office (PCO) established by MOR, consisting of key departments of MOR, including, among others, departments for planning, construction, financial and technical matters, and FCTIC, shall coordinate the two Implementing Agencies. FCTIC shall, among others, undertake the procurement of the components financed by the Loan, monitor utilization of the Loan and maintain liaison with ADB.	Loan Agreement, Schedule 6.1	Complied with. The arrangements were followed as described.
8. Zhengzhou Railway Administration Bureau (ZRAB) and Chengdu Railway Administration Bureau (CRAB) shall be the Implementing Agencies. ZRAB, through its Xiangfan Sub-Administration Bureau, shall be responsible for operation of the portion of the Project railway located in Hubei Province and CRAB, through its Chongqing Sub-Administration Bureau, shall be responsible for operation of the portion of the Project railway located in Chongqing Municipality.	Loan Agreement, Schedule 6.2	Complied with. ZRAB and CRAB were the Implementing Agencies until 2007 when MOR's Railway Construction Management Center, with ADB's concurrence, started to supervise the implementation through the onsite YWRCH. Operation of project railway was assigned to Wuhan Railway Administration Bureau for the Yichang–Liangwu section, and to CRAB for the Liangwu–Wanzhou section.
9. <b>Separation of Container Businesses.</b> MOR will ensure that its Container Center will be separated and be legally and commercially independent by the end of 2005.	Loan Agreement, Schedule 6.7	Complied with.
10. <b>Container Traffic.</b> The Borrower shall cause MOR to complete the construction of the large container terminal in Chongqing and Chengdu by the commencement of the commercial operation of the Project railway.	Loan Agreement, Schedule 6.8	Complied with. Container terminals were completed in Chongqing (December 2009), Chengdu (May 2010), and Wuhan (August 2010).
11. <b>Financial Covenant.</b> Except ADB shall otherwise agree, the Borrower shall cause MOR to maintain, for each of its fiscal years commencing from the commercial operation of the Project railway, a ratio of total operating expense to total operating revenues not higher than 75%.	Loan Agreement, Schedule 6.24	Complied with. The ratio of total operating expense to total operating revenues was 44%–31% from 2011 to 2014 and is expected to be lower than 31% after 2015.

Covenants	Reference	Status of Compliance
12. The Borrower shall cause MOR to (i) maintain separate accounts for the Project during Project implementation period; (ii) have such accounts and related financial statements audited annually, in accordance with appropriate auditing standards consistently applied, by external auditors whose qualifications, experience and terms of reference are acceptable to ADB; (iii) furnish to ADB, as soon as available but in any event not later than nine (9) months after the end of each related fiscal year, certified copies of such audited accounts and financial statements and the report of the auditors relating thereto (including the auditors' opinion on the use of the Loan proceeds and compliance with the covenants of this Loan Agreement as well as on the use of the procedures for imprest account), all in the English language; and (iv) furnish to ADB such other information concerning such accounts and financial statements and the audit thereof as ADB shall from time to time reasonably request.	Loan Agreement, Schedule 4.05	Complied with. Audit reports were submitted annually; by the end of 2011, seven such reports were submitted.
13. <b>Tariffs.</b> The Borrower shall ensure through MOR that the tariffs for the Project railway are set at levels sufficient to ensure the financial viability and sustainability of the Project railway.	Loan Agreement, Schedule 6.25	Complied with. Current tariffs will be reviewed and adjusted if necessary.
14. The Borrower shall ensure that MOR carry out a tariff study 6 months prior to trial operation of the Project railway and will advise ADB of the tariffs applied to the trial operation of the Project railway.	Loan Agreement, Schedule 6.25	Complied with. The tariff applied to the project railway was reported to ADB in time.
15. The Borrower shall, and shall cause MOR to, ensure that the tariffs applicable to the Project railway will not be lower than the currently applicable standard tariffs for the national railways in real terms.	Loan Agreement, Schedule 6.25	Complied with. Passenger tariffs of national railways and freight tariff of CNY0.2409/ton-km for local traffic and CNY0.1600/ton-km for transit traffic (higher than national level of CNY0.1200/ton-km) are applied.
16. <b>Material Institutional and Policy Changes.</b> The Borrower shall through MOR advise ADB of any institutional and/or policy changes, including, but not limited to, organizational changes, tariff policy, which may affect the construction and/or operation of the Project railway and seek ADB's concurrence if such changes will in a material manner affect the construction and operation of the Project railway and performance of the obligations of the Loan Agreement.	Loan Agreement, Schedule 6.33	Complied with. ADB has been updated on MOR's institutional and policy development in preparation of new projects.
17. <b>Construction Quality.</b> The Borrower shall ensure through MOR that the Project railway is constructed in accordance with the national technical standards, and that construction supervision, quality control, and contract management is to be performed satisfactorily.	Loan Agreement, Schedule 6.3	Complied with. The project passed MOR's check on construction quality and transportation safety assessment before the trial operation started.



Covenants	Reference	Status of Compliance
18. <b>Electrification of Dazhou–Wanzhou (Da–Wan) Railway and Yaqueling–Yichang (Ya–Yi) Line.</b> The Borrower shall ensure through MOR that the electrification of Dawan Railway and Ya–Yi Line be completed by the commencement of commercial operation of the Project railway.	Loan Agreement, Schedule 6.4	Complied with. Electrification of Dazhou–Wanzhou Railway and Yaqueling–Yichang Railway was completed.
19. <b>Connecting Railway Lines.</b> The Borrower shall ensure through MOR that the ongoing and planned railway lines (Tongling–Guichi–Jiujiang and Changjiangbu–Jinmen) be completed by the commencement of commercial operation of the Project railway.	Loan Agreement, Schedule 6.5	Complied with. In addition, the new double track and electrified Wuhan–Yichang Railway was operational in July 2012; Chongqing–Lichuan Railway was operational in July 2013.
20. <b>Capacity Constraint on Connecting Lines.</b> The Borrower shall ensure through MOR that the capacity constraint on Ya–Yi Line and/or Da–Wan Railway, once identified during the operation of the Project railway, be resolved through, among others, increasing the size of a train formation, shortening block section, and/or increasing train speed.	Loan Agreement, Schedule 6.6	Complied with. With the above development of the connecting lines, there is no capacity constraint on connecting lines at evaluation, but with increasing traffic the capacity of connecting lines need to be strengthened.
21. <b>Supply of Rolling Stock and Electricity.</b> The Borrower shall ensure that MOR provides sufficient rolling stock and adequate supply of electricity for the Project railway operation.	Loan Agreement, Schedule 6.9	Complied with. Sufficient rolling stock and electricity have been provided.
22. <b>Safety.</b> The Borrower shall ensure through MOR that the safety of passengers and freight will be ensured in accordance with the Borrower's relevant laws and regulations.	Loan Agreement, Schedule 6.10	Complied with. Safety requirements are integrated in the operational procedures of railway administration bureaus and are closely monitored.
23. <b>Safety Dissemination.</b> The Borrower shall ensure that MOR, in cooperation with the local governments, will carry out appropriate public safety campaigns through media, public announcements, household contacts and schools to familiarize people living along the Project railway route with safety issues related to the electrified railway.	Loan Agreement, Schedule 6.11	Complied with. Public safety campaigns have been conducted through newspapers, television, and public announcements. The whole alignment has been fully fenced off for operation.
24. <b>Worker's Safety at Construction Sites.</b> The Borrower shall ensure through MOR that (i) the safety of workers employed by contractors is protected and the necessary measures are taken in accordance with the Borrower's Labor Laws and the relevant regulations; and (ii) the sufficient number of clinics, appropriately equipped particularly against epidemic, will be established in the construction sites in order to ensure the health of workers.	Loan Agreement, Schedule 6.30	Complied with. Tunnel and bridge construction posed significant challenges; construction safety was systematically managed through a combination of a monitoring system on the hydrological situation, disaster alarm system, and monitoring system on structure safety; clinics were equipped at construction camps.
25. <b>Industrial Sidings.</b> The Borrower shall ensure through MOR that potential major shippers along the Project railway will be encouraged and assisted as necessary to construct and operate industrial sidings.	Loan Agreement, Schedule 6.13	Complied with. One industrial siding of 5.9 km was constructed in Enshi with annual capacity of 500,000 tons.

Covenants	Reference	Status of Compliance
26. <b>Station Access and Link Roads.</b> The Borrower shall cause, through MOR, the local governments to construct the station access roads and carry out the improvements on link roads in a timely manner prior to the commencement of commercial operation of the Project railway.	Loan Agreement, Schedule 6.12	Complied with. Station access and link roads were completed, and public bus services are provided at all the stations. In addition, 600 km of construction access roads have been handed over to the local governments.
27. <b>Local Road Network.</b> The Borrower shall cause through MOR the local governments on the Project railway alignment to implement the local road network development plan as it is planned in conjunction with Project railway construction.	Loan Agreement, Schedule 6.14	Complied with. All railway stations were connected to the local road network.
28. <b>Land Acquisition and Resettlement.</b> The Borrower shall ensure that the institutional responsibility for implementation of land acquisition and resettlement is properly carried out by the concerned local governments, on the basis of prior arrangements with MOR, which include, among others, setting up of railway construction support offices in the concerned administrative areas. The Borrower shall ensure that MOR, and shall through MOR ensure that the concerned local governments, will implement the RP in accordance with its terms, all applicable laws and regulations, and ADB's <i>Policy on Involuntary Resettlement</i> and <i>Policy on Indigenous Peoples</i> . The Borrower shall, through MOR, advise ADB if there are any substantive changes of the project scope or implementation arrangement with respect to the implementation of the RP, and submit such changes to ADB for concurrence as necessary. The Borrower shall ensure through MOR that civil works contracts include requirements to comply with the RP and ensure that MOR supervise the contractors to comply with requirements of the RP, applicable law of the Borrower and ADB policy.	Loan Agreement, Schedule 6.16	Complied with. Local governments along the alignment were responsible for implementation of land acquisition and resettlement; railway construction support offices were set up and played important roles in implementation of resettlement plan. Civil works contracts incorporated social safeguards requirements.
29. The Borrower shall ensure through MOR, Hubei Provincial Government and Chongqing Municipal Government, the timely provision of funds for land acquisition and resettlement as determined in the RP and meet any unforeseen obligations in excess of the resettlement budget. The Borrower, through MOR, shall ensure that all affected persons (AP) are compensated and assisted prior to displacement from their houses, land and assets in accordance with the RP such that they will be at least as well off as they would have been in the absence of the Project, and that the resettlement funds for compensation and entitlements as set out in the RP are fully provided to AP through the local governments and the relevant village organizations.	Loan Agreement, Schedule 6.17	Complied with. A total of CNY637.48 million of land acquisition and resettlement costs were disbursed, an increase of 89% on the CNY336.63 million estimated in the resettlement plan.

Covenants	Reference	Status of Compliance
30.	The Borrower shall ensure through MOR that the concerned local governments place priority on the vulnerable households as set out in the RP.	Loan Agreement, Schedule 6.18 Complied with. YWRCH, local railway resettlement support offices, and local governments provided various forms of assistance for vulnerable groups affected by the project.
31.	The Borrower shall cause through MOR the concerned local governments to ensure that ADB's <i>Policy on Involuntary Resettlement</i> and <i>Policy on Indigenous Peoples</i> will be applied to the associated facilities, such as the station access roads and construction service roads.	Loan Agreement, Schedule 6.19 Complied with. Compensation policies applied to associated facilities.
32.	The Borrower shall ensure, through MOR that adequate staff and resources are committed to supervision and internal monitoring of the implementation of the RP and quarterly reports on such implementation are submitted to ADB. The Borrower shall cause MOR to ensure that the adequate supervision, internal monitoring and reporting requirements for land acquisition and resettlement will be fulfilled, namely, (i) land acquisition and resettlement progress in the quarterly progress reports during implementation, (ii) notice of the completion of land acquisition, and (iii) a resettlement completion report.	Loan Agreement, Schedule 6.20 Complied with. Progress reports reflected land acquisition and resettlement information; a resettlement completion report was submitted to ADB.
33.	The Borrower shall cause MOR to contract an external domestic monitoring agency, in accordance with procedures acceptable to ADB, to carry out systematic monitoring in the contractual framework and forward reports to ADB. External monitoring shall include a baseline socioeconomic survey of households before the land is acquired. The external monitor shall conduct investigations and prepare reports annually during the period of land acquisition and resettlement, including households to be surveyed once after resettlement or until economic rehabilitation has been completed.	Loan Agreement, Schedule 6.21 Complied with. The FSDI was engaged as the external agency to conduct external monitoring and evaluation for the project. The FSDI prepared and submitted its first resettlement monitoring report to ADB in March 2005, and it subsequently submitted the second resettlement monitoring report in May 2006, the third in August 2007, and the fourth in June 2008.
34.	The Borrower shall cause through MOR the concerned local governments to ensure that all AP are provided adequate information and regularly consulted in advance of signing household compensation agreements and making other decisions that will affect their livelihoods and living conditions as a result of the Project. The Borrower shall cause MOR to ensure through the concerned local governments that the railway construction support offices maintain records of consultation and grievances.	Loan Agreement, Schedule 6.22 Complied with. County governments along the alignment disseminated resettlement booklets in the Chongqing section in October 2003 and in the Hubei section in July 2004.
35.	The Borrower shall ensure, through MOR and the concerned local governments, that the AP are provided adequate opportunities to participate in resettlement planning and implementation, particularly in income restoration measures, as set out in the RP.	Loan Agreement, Schedule 6.23 Complied with. Consultative meetings were held during implementation with local railway support offices, village committees, and the representatives of APs.

Covenants	Reference	Status of Compliance
36. <b>Sexually Transmitted Diseases.</b> The Borrower shall ensure through MOR that the information on the risks of sexually transmitted diseases, inter alia, HIV/AIDS, will be disseminated to those employed for the Project railway's construction. The Borrower shall ensure that MOR, in collaboration with the local governments, will ensure that the information dissemination of sexually transmitted diseases, inter alia, HIV/AIDS, will be conducted in the local communities of the Project area around the construction sites.	Loan Agreement, Schedule 6.31	Complied with. Clinics were established in all construction camps where such information is distributed. Local governments conducted various programs for disease prevention, particularly regarding HIV/AIDS.
37. <b>Welfare Policy Emphasis.</b> The Borrower shall cause through MOR the local government of Yichang, Enshi and Wanzhou prefectures to place a priority on welfare, social security, health care, and education, and special measures for the economic rehabilitation of the vulnerable people affected by the Project railway's construction.	Loan Agreement, Schedule 6.32	Complied with. Quality of life improved significantly as measured by major welfare indicators for medical condition, education, roads, and telecommunication, as well as broadcast coverage.
38. <b>Environment.</b> The Borrower shall ensure through MOR that the design, construction, and operation of all Project facilities comply with the national and local environmental laws and regulations and ADB's procedures, policy, and guidelines on environment. The Borrower shall cause MOR, together with the environmental protection bureaus of Chongqing Municipality and Hubei Province and the concerned prefectures and counties, to ensure that the station access and construction service roads are constructed in accordance with the national environmental requirements and ADB's policy and guidelines on environment.	Loan Agreement, Schedule 6.26	Complied with. The SEPA approved the EIA report, and the Ministry of Water Resources approved the SEPP. The SEPA approved the updated EIA in August 2006 for the double-track section.
39. The Borrower shall ensure through MOR that any adverse environmental impacts arising from construction and operation of the Project railway will be minimized by implementing the mitigation measures and monitoring program recommended in the EIA and the Summary EIA.	Loan Agreement, Schedule 6.27	Complied with. All the contractors fulfilled their obligation to protect the environment and to implement mitigation measures in their construction schemes. During operation, the impacts on the ambient environment are minor. The project will gain environment benefits from emission reduction.
40. The Borrower shall cause MOR to incorporate the recommendations in EIA into the bidding documents, the construction contract, and related documentation in an appropriate manner, so that the mitigation measures for the Chinese Sturgeon will be fully implemented within the contractual framework and in accordance with the conditions set forth in the notice of approval on the construction issued by Hubei Provincial Government.	Loan Agreement, Schedule 6.28	Complied with. The construction schedule was strictly arranged according to the EMP and conservation program. Mitigation measures were implemented adequately. Monitoring reports concluded that the Yichang bridge construction crossing the Yangtze River had no impacts on the population and spawning habitats of Chinese sturgeon.

Covenants	Reference	Status of Compliance
41. <b>Environmental Supervision Scheme.</b> The Borrower shall cause MOR to apply the environmental supervision scheme to the Project during construction of the Project railway.	Loan Agreement, Schedule 6.29	Complied with. Environmental supervision has been strictly undertaken.
42. <b>Monitoring and Evaluation.</b> The Borrower shall cause MOR to undertake the implementation of Project Performance Management System (PPMS) as agreed on with ADB to ensure that the objective of the Project is achieved and the Project facilities are managed efficiently. The Borrower shall cause MOR to collect the necessary information on Project performance as agreed to by ADB.	Loan Agreement, Schedule 6.15	Complied with. Monitoring reports have been submitted on time.

ADB = Asian Development Bank, AP = affected person, CRAB = Chengdu Railway Administration Bureau, EIA = environmental impact assessment, EMP = environmental management plan, FCTIC = Foreign Capital and Technical Import Center, FSDI = Fourth Survey and Design Institute of China Railway, km = kilometer, MOR = Ministry of Railways, PCO = project coordination office, PPMS = Project Performance Management System, RP = resettlement plan, SEPA = State Environmental Protection Administration, SEPP = soil erosion protection plan, YWRCH = Yichang–Wanzhou Railway Construction Headquarters, ZRAB = Zhengzhou Railway Administration Bureau.

Source: Asian Development Bank.

## APPENDIX 5: MAJOR EVENTS AFFECTING TRAFFIC ON THE YICHANG–WANZHOU RAILWAY

Date	Event
November 2002	Approval of PPTA (preparing the Yichang–Wanzhou Railway Project)
December 2002	Opening of Dazhou–Wanzhou Railway Line for freight service
December 2003	ADB Board approval
January 2004	Approval by the State Council of the Medium and Long-Term Railway Development Plan
September 2004	Start of construction of Yichang–Wanzhou Railway Line
November 2004	Opening of Dazhou–Wanzhou Railway Line for passenger service
June 2005	Opening of Wanzhou Railway–Waterway Connected Port Area
September 2006	Approval by the government of double-tracking a section from Yichang to Liangwu (close to Lichuan)
October 2008	Revision by the Ministry of Railways of the Medium-Term and Long-Term Railway Network Plan
December 2009	Opening of Shanghai–Chengdu–Chongqing Expressway (parallel to the Yichang–Enshi Railway Section)
October 2010	Completion of construction of Yichang–Wanzhou Railway Line
November 2010	Opening of Yichang East Station Freight Terminal
December 2010	Opening of Yichang–Wanzhou Railway Line (trial operation)
December 2010	Opening of Enshi Freight Terminal
December 2011	Closure of loan account
July 2012	Opening of Wuhan–Yichang passenger dedicated lines
January 2012	Introduction of online ticketing system
March 2013	Establishment of China Railway Corporation
July 2013	Opening of Lichuan–Chongqing passenger dedicated line
July 2014	Start of operations of high-speed trains on the Yichang–Wanzhou Railway Line
2016 (estimated)	Opening of Chongqing–Wanzhou passenger dedicated line
2018 (estimated)	Double tracking of Yichang–Yaqueling freight line
2021 (estimated)	Opening of Zhengzhou–Wanzhou passenger dedicated line

ADB = Asian Development Bank, PPTA = project preparatory technical assistance.

Source: ADB Independent Evaluation Department.

## APPENDIX 6: ECONOMIC AND FINANCIAL REEVALUATION

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1. The traffic forecasts are based on the actual performance of the Yichang–Wanzhou Railway (YWR) from January 2011 to August 2015, expected economic growth, and anticipated future investments in transport infrastructure.
2. Significant transport infrastructure development took place in the project area during implementation, notably the completion in December 2009 of the Yichang–Wanzhou Expressway, which forms part of the expressway trunk connecting Shanghai and Chengdu. Developments in the rail system have also affected the YWR, changing it from a mixed railway to a passenger-dominated one.
3. YWR is not a self-standing project—in 2014, only 7% of passengers using the line have both origin and destination at one of its stations, and more than 60% are through passengers. So the completion of the Wuhan–Yichang Railway in 2012 and the Chongqing–Lichuan Railway in 2013, both passenger-dedicated lines on the Shanghai–Chongqing–Chengdu high-speed railway corridor, has boosted the YWR’s passenger traffic levels. The opening of these projects and introduction of electric multiple units in July 2014 explain why YWR passenger volumes doubled between 2011 and 2014 (increasing from 10.5 million to 21.1 million), and why in 2014 they were about 70% above expected at appraisal.
4. YWR passengers in 2015 were estimated to increase 25% from 2014, from actual numbers of those who used YWR stations from January to August 2015. Passenger growth is assumed to continue at 8% per year until 2024 when it is expected to reach nearly 50 million passengers. This growth rate is considered reasonable given that the YWR forms a link in the Shanghai–Chengdu railway corridor. This level of traffic would require more than 100 train pairs per day, and it is assumed that further growth will be constrained by line capacity (unless further major investments are made—China Railway Corporation estimates that capacity utilization is 56% for the double-track section and 62% for the single-track section). It is therefore assumed that, after 2025, passenger growth rate would fall to 2% per year due to minor operational changes to increase capacity.
5. Freight traffic, in contrast, has been far below expectations. It was less than 1 million tons in 2014 (compared to 20 million tons at appraisal). Yet road traffic in the corridor was about 20 million–30 million tons in 2011, and substantial volumes are also carried by water on the Yangtze River, parallel to the YWR. The filling of the Three Gorges Dam’s reservoir in the late 2000s affected the navigation capacity of the Yangtze River and has made water transport more competitive for freight. This led to the development of a rail–water connection in Wanzhou in 2005 and to the introduction of larger ships on the Yangtze River in 2010. Further, the increase in the capacity of the Xiangyu rail line north of the YWR, and capacity constraints on adjacent single-track lines that feed traffic on to the YWR<sup>1</sup> (Yichang–Yaqueling, Jinmen–Changjiangfu, Dazhou–Wanzhou, and Wuhan–Macheng lines) but are now operating at nearly full capacity, have meant that, where long-distance freight traffic uses rail, it is unlikely to use the YWR. That said, the freight forecasts at appraisal were not realistic, and some of these developments should perhaps have been anticipated at the planning stage.
6. YWR freight traffic depends on local freight transport needs. In general, it takes more time for freight traffic to grow than passenger traffic after operation of railway lines. A freight railway terminal in Enshi, which was established by the private sector and the local government, has a capacity expansion plan. If local freight traffic increases, 3 pairs of freight trains per day may not be enough in the future. In this case, capacities of adjacent lines of the YWR need to be increased, and the number of freight trains should be increased to capture local freight transport needs. In this recalculation of the

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<sup>1</sup> The Yichang–Yaqueling line has capacity constraints, but it will be double tracked by 2018.

economic internal rate of return (EIRR) and financial internal rate of return (FIRR), the increase of freight traffic with investment of adjacent lines was not incorporated to be conservative in the calculation.

7. The YWR was the first national railway line in the People’s Republic of China to incorporate in its design the dimension requirements for operating double-stack container trains. Experience in other countries has shown that double-stack container operation increases carrying capacity by about 60% and reduces costs by about 40%. However, double-stack container operations have not so far been started anywhere in the People’s Republic of China, and, even when they are, it seems unlikely the YWR will be used for them. YWR capacity is likely to continue to be used mainly for passenger trains, as China Railway Corporation’s policy is to have separate lines for passenger and freight operations to maximize capacity use (capacity is maximized by having all trains operate at the same speed).

8. Currently up to 45 pairs of passenger trains (mainly high-speed trains [HSTs]) and three pairs of freight trains operate on the YWR each day, though the number varies by section. On the single-track section between Lichuan and Wanzhou, only “normal” passenger trains and no freight trains operate.

**Table A6.1: Train Pairs per Day on Yichang–Wanzhou Railway, by Section**

Section	Yichang East–Enshi (double track)	Enshi–Lichuan (double track)	Lichuan–Wanzhou (single track)
HST “G” <sup>a</sup>	6	6	-
HST “D” <sup>b</sup>	25	24	-
Normal trains	14	11	8
Total pairs of passenger trains	45	41	8
Pairs of freight trains	3	3	-
Total pairs	48	44	8
Capacity utilization	56%	51%	67%
Capacity	86	86	12

HST = high-speed train.

<sup>a</sup> The HSTs have a maximum design speed of 300–350 kilometers per hour (km/h).

<sup>b</sup> The HSTs have a maximum design speed of 250 km/h.

Note: The number of train pairs shows only for scheduled trains. Extra trains in busy seasons are not included in the trains in the table.

Source: Asian Development Bank Independent Evaluation Mission collected data from the China Railway Corporation.

9. Nearly 90% of trains are through trains with only a few trains terminating on the line at Enshi or Lichuan. To the west of the YWR, half of transit trains use the mixed-purpose line between Wanzhou and Dazhou (and on to Chengdu), and slightly under half use the passenger-dedicated line between Lichuan and Chongqing. To the east, trains run to various coastal cities, Beijing, or the area around Wuhan.

10. The 2014 traffic and updated traffic forecasts are presented in Table A6.2.

**Table A6.2: Traffic Projections for Yichang–Wanzhou Railway**

Item	2014	2025	2035
Passengers (million passengers)	21.1	52.9	65.6
Freight traffic (million tons)	0.7	1.3	1.3

Source: Asian Development Bank.

## A. Economic Benefits

11. The economic reevaluation is undertaken using with- and without-project scenarios. In the without-project case, existing roads and waterways in the project corridor and alternative railway routes would be relied upon.



12. The reevaluation quantified the benefits from (i) time savings of passengers diverted from buses, the Xiangfan–Chongqing (Xiangyu) national rail line, and waterways; (ii) operating cost savings for passengers, estimated as the difference between traveling on the YWR and traveling by bus; (iii) operating cost savings of diverted freight traffic from trucks (unlike in the appraisal, the freight traffic time savings were not included in the benefit calculations); and (iv) additional tourism benefits attributable to the YWR that are not included in transport benefits.

13. The value of time savings of passengers was calculated from the average national wages of city workers in 2013, CNY51,000 per year which, assuming they work 2,000 hours per year, gives an hourly rate of CNY25. But rail travelers generally have above-average wages. The time savings for business travelers is valued at their wage plus any additional employment cost. On the other hand, most passengers are travelling in their own time, and international studies show that leisure passengers value travel time savings far less than their wages.<sup>2</sup> Based on these considerations, a value of time savings of CNY20 per hour has been assumed for 2013.<sup>3</sup> The average time saving per YWR passenger is estimated to be 4 hours, giving an average saving of CNY80 per trip. A further CNY6 per passenger trip is estimated to be saved from the lower operating cost of rail relative to bus.

14. The benefits from tourism development were not anticipated at appraisal, but there is evidence that significant tourism benefits exist that are not fully reflected in transport benefits. Tourism benefits from the line are expected to be significant. The project area is rich in tourism resources that were not tapped before the project because of the poor transport conditions. Enshi prefecture had 16.3 million tourist visits in 2011, 56% higher than the previous year, and tourism revenues were CNY8.6 billion, 71% higher than the previous year. By 2013, there were 26.5 million visits and tourism revenues were CNY14.8 billion. Between 20% and 40% of Enshi prefecture tourists use the YWR. The tourism sector's value added was based on the net of output at economic prices less the cost of production (sum of all intermediate input costs, wages, and annualized investment costs). It was assumed that tourism's cost of production is 70% of the value of output and that 30% of the tourism sector's incremental value added (compared to 2010) is attributable to the railway.

15. There are also network benefits, as the YWR released capacity for freight transport on the Xiangyu Line by shifting passenger trains on to the YWR. More significantly, there are potentially large benefits from additional traffic on the Wuhan–Yichang and Chongqing–Lichuan passenger-dedicated rail lines that link with the YWR. In the absence of the YWR, there would have been no means of connecting the passenger-dedicated lines between Wuhan and Chongqing. However, it was not possible to quantify these benefits since large-scale surveys were not conducted for the project performance evaluation report. On the other hand, the YWR may receive spillover benefits from other lines on the Shanghai–Wuhan–Chongqing–Chengdu corridor. The YWR has lower maximum speed of 160km/h compared with other lines of the corridor, and thus the YWR's construction costs are relatively lower. The YWR eventually attracts a large number of passengers with high speed rail service of other lines on the corridor which have higher maximum speeds with larger investments.

16. With the diversion of passengers and freight from road to rail, there will be benefits due to reduced air and noise pollution and carbon emissions from cars, trucks, buses, and aircrafts, as well as fewer accidents. However, these benefits are expected to be less significant given the limited amount of freight traffic diverted to the line (the environmental costs of road freight traffic are higher than for buses). Again, it was not possible to quantify these benefits since environmental and safety costs of roads are not readily available.

<sup>2</sup> In the United Kingdom, surveys show that leisure travellers value time savings at 25% of their wage rates. Source: Department for Transport, 2009. *Values of Time and Operating Costs: TAG Unit 3.5.6*. London.

<sup>3</sup> The average real wage has grown at 10% per year since 2000 and is assumed to increase at 6% per year up to 2020 and 3% per year thereafter.

17. Benefits from passenger traffic are the biggest source of economic benefits, followed by those from tourism and freight traffic.

## B. Costs

18. The project costs consist of capital costs, costs for infrastructure rehabilitation to be undertaken during the evaluation period (taken as up to 2043), and operation and maintenance costs. The incremental cost of rolling stock is annualized and forms part of the unit operating costs. Financial costs were converted to economic costs following the same factors as at appraisal (multiplied by 0.92 for capital and rehabilitation costs and 0.8 for operation and maintenance cost).

## C. Economic Internal Rate of Return Reevaluation

19. The recalculated EIRR was 14.1% (Table A6.3), slightly less than the 14.4% estimated at appraisal and the 15.6% estimated in the project completion report (PCR). While the methodologies of calculating the EIRR were different, there is no significant variance from the appraisal due to much higher passenger traffic than estimated in spite of higher capital cost for double tracking. The variance from the PCR is mainly due to unquantified benefits in the project performance evaluation report. The EIRR exceeds the cut-off rate of 12.0%, and the project is therefore economically viable.

**Table A6.3 Economic Reevaluation**  
(CNY million)

Year	Capital Cost	O&M Costs	Passenger Benefits	Freight Benefits	Tourism Benefits	Net Benefits
2003	202	-	-	-	-	(202)
2004	1,797	-	-	-	-	(1,797)
2005	3,334	-	-	-	-	(3,334)
2006	4,530	-	-	-	-	(4,530)
2007	3,326	-	-	-	-	(3,326)
2008	3,035	-	-	-	-	(3,035)
2009	2,639	-	-	-	-	(2,639)
2010	3,460	-	-	-	-	(3,460)
2011	1,048	249	778	52	120	(348)
2012	-	290	962	65	300	1,037
2013	-	331	1,294	78	500	1,541
2014	-	358	1,908	91	737	2,378
2015	96	373	2,505	78	968	3,082
2016	-	387	2,840	89	1,098	3,640
2017	-	403	3,221	103	1,245	4,165
2018	1,403	419	3,652	118	1,411	3,360
2019	-	436	4,142	136	1,601	5,442
2020	96	453	4,697	150	1,815	6,112
2021	-	471	5,326	154	2,058	7,067
2022	-	490	6,040	159	2,334	8,042
2023	-	510	6,849	163	2,647	9,149
2024	188	530	7,767	168	3,001	10,219
2025	367	552	8,318	168	3,214	10,782
2026	1,403	568	8,739	168	3,377	10,314
2027	-	585	9,181	168	3,548	12,313
2028	-	603	9,646	168	3,728	12,939
2029	-	621	10,134	168	3,916	13,598
2030	96	639	10,647	168	4,114	14,194
2031	-	659	11,185	168	4,323	15,018
2032	-	678	11,751	168	4,541	15,783
2033	-	699	12,346	168	4,771	16,587

Year	Capital Cost	O&M Costs	Passenger Benefits	Freight Benefits	Tourism Benefits	Net Benefits
2034	1,403	720	12,971	168	5,012	16,029
2035	570	741	13,627	168	5,266	17,750
2036	-	763	14,317	168	5,533	19,254
2037	-	786	15,041	168	5,812	20,236
2038	188	810	15,802	168	6,107	21,079
2039	-	834	16,602	168	6,416	22,351
2040	367	859	17,442	168	6,740	23,124
2041	-	885	18,324	168	7,081	24,689
2042	14	912	19,251	168	7,440	25,934
2043	(3,114)	939	20,226	168	7,816	40,385
<b>EIRR</b>						<b>14.1%</b>

EIRR = economic internal rate of return, O&M = operation and maintenance.

Source: Asian Development Bank estimates.

20. Sensitivity analysis was carried out to test the impacts of (i) a decrease in passenger traffic growth forecast, (ii) a decrease in tourism benefits, and (iii) an increase in operation and maintenance costs (Table A6.4). According to the results of the analysis, the project will continue to be economically viable under these assumptions.

**Table A6.4: Sensitivity Analysis–Economic**

Scenario	Change by (%)	EIRR (%)
Base case		14.1
Passenger traffic growth rate	-50	12.9
Tourism benefits	-50	13.1
Working expenses	+50	13.6

EIRR = economic internal rate of return.

Source: Asian Development Bank.

## D. Basic Assumptions for Financial Analysis

21. The FIRR for the YWR project was reevaluated using financial and operational information obtained from the Wuhan Railway Administration and Chengdu Railway Administration. Capital cost was based on actual project expenditures incurred, excluding interest and other financial charges during construction. All revenues and expenses were expressed in 2014 prices for the financial reevaluation. Construction costs were assumed to be unchanged from the 2011 prices used in the PCR report (as construction prices have hardly changed). The calculation period covered construction and operation to 2043, which is consistent with the evaluation at appraisal. Costs of equipment replacement and infrastructure rehabilitation to occur during the calculation period were included. Residual value was calculated based on the economic life of civil works.

22. Project revenues consisted of passenger, freight, and other revenues. The assumed YWR passenger tariff was CNY0.24 per passenger-kilometer in 2014 prices throughout the life of the project. The assumed freight tariff was CNY0.30 per ton-kilometer, since YWR tariffs are about twice the national freight tariff. No increase in the current tariffs in real terms has been assumed in the reevaluation. Other revenues were assumed to be 10% of freight and passenger revenues. Business tax and income tax were deducted from the net benefits.

23. The YWR's operating cost is higher than ordinary railways given the gradient and the fact that 74% of the alignment is in tunnels and bridges. Based on the 4 years of YWR operational experience, the operating costs, including rolling stock costs, have been projected assuming they increase by 4% per year 2015–2025 and 3% per year thereafter.

## E. Financial Internal Rate of Return

24. The FIRR after tax was recalculated at 5.7% (Table A6.5), compared with 5.8% estimated at appraisal and 3.9% estimated in the PCR. The variance from the PCR is mainly because of greater-than-expected passenger numbers and the higher assumed passenger tariff (CNY0.24 instead of CNY0.15). The FIRR is well above the weighted average cost of capital of 2.5%, and the project is therefore considered financially viable.

**Table A6.5: Financial Internal Rate of Return**  
(CNY Million)

Year	Capital Costs	Working Expenditures	Passenger Revenue	Freight Revenue	Other Revenue	Taxes Paid	Net Cash Flow
2003	220	0	0	0	0	0	(220)
2004	1,953	0	0	0	0	0	(1,953)
2005	3,624	0	0	0	0	0	(3,624)
2006	4,924	0	0	0	0	0	(4,924)
2007	3,615	0	0	0	0	0	(3,615)
2008	3,299	0	0	0	0	0	(3,299)
2009	2,868	0	0	0	0	0	(2,868)
2010	3,761	4	3	1	0	0	(3,761)
2011	1,139	312	633	17	65	21	(756)
2012	0	362	725	22	75	24	435
2013	0	413	906	26	93	30	582
2014	0	448	1,273	30	130	42	944
2015	104	466	1,591	26	162	52	1,157
2016	0	484	1,719	30	175	56	1,383
2017	0	504	1,856	34	189	60	1,515
2018	1,525	524	2,004	39	204	65	134
2019	0	545	2,165	45	221	71	1,816
2020	104	567	2,338	50	239	76	1,880
2021	0	589	2,525	51	258	82	2,162
2022	0	613	2,727	53	278	89	2,356
2023	0	637	2,945	54	300	96	2,566
2024	204	663	3,181	56	324	104	2,590
2025	399	689	3,244	56	330	106	2,437
2026	1,525	710	3,309	56	337	108	1,359
2027	0	731	3,376	56	343	110	2,934
2028	0	753	3,443	56	350	112	2,984
2029	0	776	3,512	56	357	114	3,035
2030	104	799	3,582	56	364	116	2,982
2031	0	823	3,654	56	371	119	3,139
2032	0	848	3,727	56	378	121	3,192
2033	0	873	3,801	56	386	123	3,247
2034	1,525	900	3,877	56	393	126	1,777
2035	620	927	3,955	56	401	128	2,737
2036	0	954	4,034	56	409	131	3,414
2037	0	983	4,115	56	417	133	3,472
2038	204	1,012	4,197	56	425	136	3,326
2039	0	1,043	4,281	56	434	139	3,589
2040	399	1,074	4,367	56	442	142	3,250
2041	0	1,106	4,454	56	451	144	3,710
2042	15	1,139	4,543	56	460	147	3,757
2043	(14,254)	1,174	4,634	56	469	150	18,089
						<b>FIRR</b>	<b>5.7%</b>

FIRR = financial internal rate of return.

Source: Asian Development Bank.

25. Sensitivity analysis (Table A6.6) was conducted to test the impact of variations in passenger traffic growth, and in operation and maintenance costs. The project will still remain viable under different sensitivity tests, as the FIRRs remain higher than the weighted average cost of capital.

**Table A6.6: Sensitivity Analysis–Financial**

Scenario	Change by (%)	FIRR (%)
Base case		5.7
Passenger traffic growth rate	-50	4.4
Working expenses	50	4.9

FIRR = financial internal rate of return.

Source: Asian Development Bank.